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I.

A STUDY OF PLASTER-OF-PARIS BANDAGES.

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I. INTRODUCTION.

The object of this contribution is to give the results of practical experiments made with the plaster-of-Paris bandage and to offer a few points of interest which have been noted during this study; also to show the direct practical bearing of plaster-of-Paris when influenced by substances which shorten or lengthen its setting time and which weaken or strengthen the contexture of the resulting plaster-of Paris dressing.

It is fair to assume, that if we have a plaster bandage of the weaker type, that we must necessarily use more material and make the dressing thicker in direct proportion to its weakness, if we wish to do a given amount of work. It is very rightly believed by the orthopedic surgeons both in this country and abroad, that the best plaster dressing is the one which is the thinnest and at the same time the strongest. The true working knowledge of the bandage at hand will help materially toward the application of this kind of dressing; the lack of this knowledge is well illustrated by the unnecessarily thick and bulky dressings that we often encounter in the clinics where men are being taught the use of the plaster-of-Paris bandage.

It is essential in making plaster tests, that some standard for comparison and a unit of measure be adopted. This has been

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entirely overlooked in the previous work done in this line, and deserves mention here. The standard for comparison in the present work is the quick-setting plaster, mixed in water at seventy degrees Fahrenheit, and the units of measure used are the pound, the minute and the second.

Many writers have advocated the use of substances like sodium chloride to hasten the setting time, but have failed to note the weakening effect of these substances on the resulting dressing; also the amount to be added plays an important part, namely, a small amount of sodium chloride hastens the set, whereas a large amount of the same retards the set. The amount and effect of these substances may only be noted by accurate experiments based on a comparison with the normal plaster. There may be much diversity of opinion in regard to the material used but it is unanimously granted that in order to approach the ideal plaster dressing, we must have one which will conform to the following three things; i.e., strength, lightness in weight, and one that will set in a reasonable time.

Therefore the question at issue is, *can we modify the plaster-of-Paris dressing* so that it will be stronger, lighter, and at the time, set quickly. It was with the above question in mind that this work was undertaken. A discussion of the value of a properly applied plaster dressing as compared with some of the other methods of treating orthopedic cases will not be entered upon here; nevertheless, it was considered important enough to make extensive experiments with plaster and the plaster bandage. It is obvious that in work of this character, many errors of technique and observation may arise; in doing this work, every care possible was taken, both by the assistants and the nurses, in order that these errors might be held at a minimum.

About two years ago, at the Children's Hospital, Boston, the writer made a few trial experiments with plaster-of-Paris, using dextrin, sulfate of potassium, chloride of sodium and Portland cement in different amounts. It was then noted that the setting time of these differed in density and weight to an astonishing degree; for example, a given amount of plaster with the addition of salt, when dry, had the consistency of chalk, while the same amount of the same plaster, with the addition of dextrin, when dry had the consistency of marble. It then occurred that the plaster bandage dressing could be so modified as to give the greatest strength and toughness, with the least amount of plaster bandage, and that consequently we would have a very light weight dressing, that would do the desired work, in place of a heavy, unsightly, thick one. By virtue of the early experiments, it was at first thought that by the addition of dextrin to the water, this result could be accomplished, but it was soon learned that with it the setting time was so prolonged as to make it impractical, so other substances were used, the best of which has proven to be Portland cement.

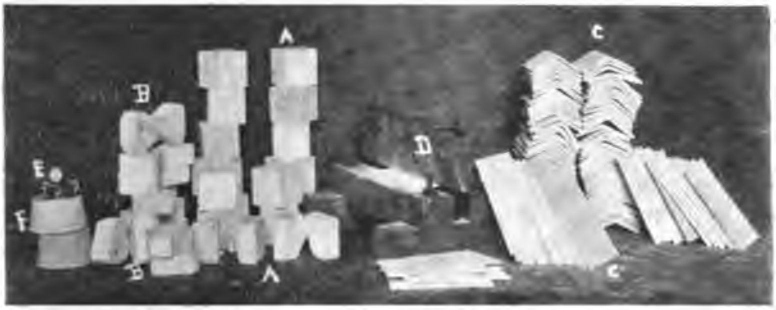

FIG. 1. Showing, A—the cubes used; before and after the crushing tests. B—the forms used; before and after the tensile tests. C—the plaster bandage slabs; before and after the breaking tests. D—apparatus for breaking the plaster bandage slabs; it being placed in the Olsen machine (Fig. 4) when used. E—cylinders used to test the porosity. F—discs used to obtain the setting time.

The clinical part of the work was done at the Children's Hospital, Boston; through the very great kindness of Dr. Lovett, every chance for accurate work was made possible. The actual tests were made in the testing laboratory of the Massachusetts Institute of Technology; through the generosity of Prof. Miller of that institution, the very best apparatus was at my disposal.

In order to come to definite conclusions, it was necessary to make the experiments in two groups: Group I, the plaster tests. Group II, the plaster bandage tests. The results of these tests are shown in Charts I and II respectively. In each case, three tests were made and the average taken and recorded on the charts.

It can easily be understood that in order to obtain the best results in the application of the plaster-of-Paris dressing, either in operative or non-operative cases, it is essential that the surgeon thoroughly understands the action of the material at hand, namely, the plaster itself, the crinoline, and the plaster-of-Paris bandage as a whole; this is especially true when it is desired to hasten or retard the setting time, or when an unusually strong dressing is the object; therefore, it will not be considered amiss to begin with the plaster-of-Paris itself.

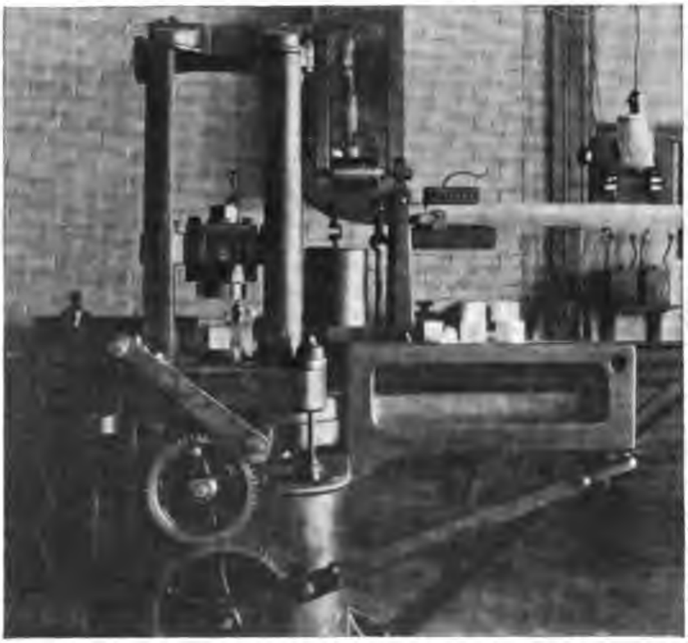

FIG. 2. Showing the Olsen machine used to determine the crushing force.

II. PLASTER-OF-PARIS.

Plaster-of-Paris is chemically a native sulfate of lime. In its crude state it is called gypsum and is prepared for use by being reduced to a fine powder and subsequently calcined in ovens at a temperature between 300 degrees and 400 degrees Fahrenheit. When pure, properly ground and mixed with water, a chemical union takes place which is called recrystalization or "setting." If overheated in the calcining process, it parts with all of its water and fails to recrystalize when again mixed with water. It expands one five-hundredths of its own measurement when used in bulk; when used as a plaster bandage, the incorporated gauze has a tendency to shrink. This expansion and shrinkage counteract each other and the result is practically *nil*.

There are two kinds of plaster-of-Paris in general use for orthopedic work:

1. Finely ground quick setting, commonly known as "dental."
2. Coarsely ground slow setting, commonly known as "commercial."

The two kinds of plaster show a marked difference in their set, density, crushing force, and tensile strength. Samples of both of these were taken from fresh barrels and sent to the chemist of the Harvard Medical School for qualitative analysis and it was reported that neither contained sodium chloride, alumn, sulfate of potassium nor dextrin. It will be seen at once, by consulting the charts that the slow plaster is unfit for use with the bandage. Both of these plasters may, however, be used for impression work with good results. When used in this way, they should be prepared each as follows:

The quick setting plaster should be mixed in the proportions of seven parts of plaster to four parts of water by volume. Water of about seventy degrees Fahrenheit should be placed in a convenient receptacle and the plaster added by sprinkling it upon the water's surface while the latter is being kept in constant motion with a large spoon, held lightly tilted, stirring in an oval rather than a circular motion; thus we get a plaster cream of the greatest efficiency containing the least amount of air.

The slow plaster, on the other hand, should be mixed in the proportions of eight parts of plaster to four parts of water, also at a temperature of seventy degrees Fahrenheit, but in this case the plaster should all be poured into the water without stirring;

after all the plaster has been added, and the water has thoroughly penetrated it, it should be gently stirred.

The manufacture of plaster-of-Paris is a secret process, but it seems evident from its behavior, that the essential difference between the two kinds remains in the matter of refinement and the degree of temperature used in the calcining process.

Setting or recrystalization is brought about by a combined chemical and mechanical action of the molecules of calcium sulfate; an example of the former is the latent heat which plaster generates during the setting process. The latter is well illustrated under the microscope*. This mechanical action has a direct practical bearing and explains why the plaster dressings should be manipulated in the initial setting time and not be disturbed after the actual setting time has begun; also that the common practice of completing the plaster dressing by rubbing either water or plaster cream upon it, after the actual set has taken place, is entirely wrong and tends to weaken rather than strengthen the dressing.

A. SUBJECTS INVESTIGATED.

The data collected in Chart I, consists of the plaster tests without the gauze. The quick setting plaster was used in all but a few instances and No. 3 was used for the standard of comparison. The things investigated in these experiments were:

1. Time of set,
2. Crushing force,
3. Tensile strength,
4. Porosity.

As has been stated above, it is necessary to have some measure for the estimation of a relative comparison; thus the time of set is given in minutes; the crushing force in pounds; the tensile strength in pounds, and the porosity in seconds.

(*a*) *Time of Set.*

This was obtained by the apparatus shown in Fig. 5 and consists of a sliding shaft held in a vertical position by a stationary standard. On the shaft is an indicator which moves over a graduated scale. At the lower end of this sliding shaft, a needle is attached.

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* This simple experiment is best performed by placing a small amount of plaster on a thin slide, and allowing a fine stream of vapor to slowly pass over the plaster. During the process of recrystalization, the particles of plaster will be seen to leap into their final place.

The time of set is divided into three stages, i.e.:

1. Initial,
2. Final,
3. Actual.

1. The initial set is obtained from the time the plaster enters the cup of the apparatus, until the indicator appears above the zero mark on the scale; that is, when the needle ceases to penetrate the entire thickness of the plaster in the cup.

2. The final set is estimated from the beginning of the initial set, to that time in which the needle fails to penetrate or even indent the plaster.

3. The actual set is the difference between the final and initial set and is that period in which the plaster is reorganizing.

Plaster should be manipulated during the initial set and *disturbed as little as possible during the actual setting time.* This explains why speed in the application of the plaster bandage is of great importance.

(*b*) *Crushing Force.*

By the crushing force is meant the actual weight-bearing ability of a given amount of plaster-of-Paris. This force can best be determined by estimating the amount of force which is required to crush the plaster. In order to estimate this, it is necessary that each piece of plaster tested should be the same size and shape, and that the plaster should contain as few flaws as possible. Perfect two-inch cubes were cast by pouring the various plaster mixtures into emery ground bisected moulds. After these had set they were removed from the moulds and allowed to become air dry. (Fig. 1, A.) These cubes were then placed under the Olsen machine (Fig. 2) and graduated pressure applied. The machine for this purpose consists of a highly geared train of cog wheels with a recording graduated balance, and is capable of registering enormous pressure very exactly. After some experience, pressure anywhere from a half to forty-eight thousand pounds

CHART I. PLASTER TESTS.

Quick setting plaster used in all except 29 and 30. Temp. of solution = 70 degrees F.

	MIXTURE.	PROPORTION.	SETTING TIME. IN MINUTES.			CRUSHING FORCE. IN POUNDS.			TENSILE FORCE. IN POUNDS.			POROSITY. IN SECONDS.			REMARKS.
						2-inch Cubes.			1-inch Square Bar.			Time in seconds required for 10 c.c. air to pass through.			
			Initial.	Final	Actual.	1.	2.	Average.	1.	2.	Average.	1.	2.	Average.	
No. 1	Plaster	Plaster, 1 part Water, 2 parts	26+	56+	30+	280	280	280	22	20	21	15	15	15	
No. 2	Plaster	Plaster Water, *aa*	10	15.5	5.5	2500	2400	2450	140	150	145	85	85	85	
No. 3	Plaster	Plaster, 7 parts Water, 4 parts	4.0	12.	8.0	3200	3400	3300	208	224	216	285	285	285	Standard.
No. 4	Plaster	Plaster, 8 parts Water, 4 parts	3.5	6.0	2.5	6910	6750	6830	267	272	269.5	310	310	310	Sets too quickly.
No. 5	Plaster and Salt	Plaster, 7 parts 1% Salt Sol., 4 parts	2.5	6.0	3.5	3080	2905	2992.5	103	140	121.5	135	135	135	
No. 6	Plaster and Salt	Plaster, 7 parts 5% Salt Sol., 4 parts	0.5	1.5	1.0	1450	1280	1365	55	50	52.5	110	110	110	
No. 7	Plaster and Salt	Plaster, 7 parts 20% Salt Sol., 4 parts	4.0	7.0	3.0	660	720	969	10	21	15.5	1920	1830	1830	
No. 8	Plaster and Dextrin	Plaster, 7 parts 1% Dextrin Sol., 4 parts	4.5	12.5	8.0	3440	3590	3515	260	278	269	220	220	220	
No. 9	Plaster and Dextrin	Plaster, 7 parts 5% Dextrin Sol., 4 parts	6.0	15.	9.0	6780	6910	6845	288	285	286.5	380	370	375	
No. 10	Plaster and Dextrin	Plaster, 7 parts 20% Dextrin Sol., 4 parts	8.0	21.	13.	6150	6570	6360	290	286	292	440	480	460	
No. 11	Plaster Dextrin Salt	Plaster, 7 parts Dextrin Sol., 2% } 4 parts Salt Sol., 2% }	3.0	4.5	1.5	1500	1700	1600	90	85	87.5	180	180	180	
No. 12	Plaster and Starch	Plaster, 7 parts 1% Starch Sol., 4 parts	3.5	10.5	7.0	4545	4210	4377.5	276	296	286	310	310	310	
No. 13	Plaster and Starch	Plaster, 7 parts 5% Starch Sol., 4 parts	5.0	14.	9.0	3190	3020	3105	272	268	270	345	345	345	

	MIXTURE.	PROPORTION.	SETTING TIME. IN MINUTES.			CRUSHING FORCE. IN POUNDS.			TENSILE FORCE. IN POUNDS.			POROSITY. IN SECONDS.			REMARKS.
						2-inch Cubes.			1-inch Square Bar.			Time in seconds required for 10 c.c. air to pass through.			
			Initial.	Final	Actual.	1.	2.	Average.	1.	2.	Average.	1.	2.	Average.	
No. 14	Plaster Cement (Portland)	Plaster, 99 } Cement, 1 } 7 parts Water, 4 parts	3.5	8.5	5.0	3430	3350	3390	166	221	193.5	275	275	275	
No. 15	Plaster, 98 Cement (Portland)	Plaster, 98 } Cement, 2 } 7 parts Water, 4 parts	3.0	7.5	4.5	4860	4610	4735	261	220	240.5	260	260	260	
No. 16	Plaster Cement (Portland)	Plaster, 95 } Cement, 5 } 7 parts Water, 4 parts	2.0	6.0	4.0	5250	5560	5405	266	276	271	200	200	200	
No. 17	Plaster Cement (Portland)	Plaster, 90 } Cement, 10 } 7 parts Water, 4 parts	1.5	6.0	4.5	4845	4765	4805	295	268	281.5	150	150	150	
No. 18	Plaster Cement (Portland)	Plaster, 80 } Cement, 20 } 7 parts Water, 4 parts	5.0	9.5	4.5	4850	5010	4930	263	236	249.5	120	120	120	
No. 19	Plaster Cement Salt	Plaster, 99 } Cement, 1 } 7 parts 5% Salt Sol., 4 parts	2.0	3.0	1.0	1620	1470	1545	50	40	45	85	85	85	
No. 20	Plaster Cement Salt	Plaster, 98 } Cement, 2 } 7 parts 5% Salt Sol., 4 parts	2.25	3.25	1.0	1060	1020	1040	46	46	46	80	80	88	
No. 21	Plaster Cement Salt	Plaster, 95 } Cement, 5 } 7 parts 5% Salt Sol., 4 parts	2.5	3.5	1.0	1950	1840	1895	60	80	70	75	75	75	
No. 22	Plaster Cement Salt	Plaster, 90 } Cement, 10 } 7 parts 5% Salt Sol., 4 parts	2.50	3.75	1.25	1420	1100	1260	90	80	85	70	70	70	
No. 23	Plaster Cement Dextrin	Plaster, 99 } Cement, 1 } 7 parts Dextrin, 5% Sol., 4 parts	6.00	12.0	6.0	2520	2800	2660	235	220	227.5	190	196	193	
No. 24	Plaster Cement Dextrin	Plaster, 98 } Cement, 2 } 7 parts 5% Dextrin Sol., 4 parts	5.0	10.5	5.5	2610	2250	2430	190	230	210	165	165	165	

	Mixture.	**Proportion.**	**Setting Time. in minutes.**			**Crushing Force. in pounds.**			**Tensile Force. in pounds.**			**Porosity. in seconds.**			**Remarks.**
						2-inch Cubes.			1-inch Square Bar.			Time in seconds required for 10 c.c. air to pass through.			
			Initial.	Final.	Actual.	1.	2.	Average.	1.	2.	Average.	1.	2.	Average.	
No. 25	Plaster Cement Dextrin	Plaster, 95 } 7 parts Cement, 5 } 5% Dextrin Sol., 4 parts	25.0	45.0	20.0	2690	2850	2770	66	88	77	100	100	100	
No. 26	Plaster Cement Dextrin	Plaster, 90 } 7 parts Cement, 10 } 5% Dextrin Sol., 4 parts	25.0+	45.0+	20.0+	2430	2150	2290	130	140	135	50	50	50	
No. 27	Plaster Cement Dextrin Salt	Plaster, 90 } 7 parts Cement, 10 } 2% Salt Sol., } 4 parts 2% Dextrin Sol., }	1.5	5.0	3.5	900	850	875	110	108	109	240	240	240	
No. 28	Cement (Portland)	Cement, 8 parts Water, 3 parts	80.0+	4hrs.+	x x	19580	21240	20410	620	740	680	x	x	x	
No. 29	Plaster (slow) (coarse)	Plaster, 9 parts Water, 4 parts	20.0	37.0	17.0	6750	6450	6600	390	340	365	245	245	245	Sets very slowly.
No. 30	Plaster (slow) (coarse) Salt	Plaster, 9 parts 5% Salt Sol., 4 parts	5.0	9.0	4.0	2080	2070	2075	60	54	57	200	190	195	

can be recorded. This is done by first placing the cube to be tested upon the steel platform of the machine, and by having the assistant slowly turn the crank, the pressure is delivered. While this steady pressure is being borne by the plaster cube in the machine, the operator gradually shifts the sliding block toward the distal end of the balance scale, and at the very instant the cube crushes, the load is released and the scale drops and refuses further to record; at this instance the scale is read and thus is obtained the crushing force of that particular cube.

(*c*) *Tensile Strength.*

The adhesion or tensile strength of plaster plays an important rôle in the sum total strength of a given amount of plaster. In order to test this, casts were moulded, the shape of a figure of eight (Fig. 1, B), the process of making these being the same as that described under crushing force above. These casts were placed into the apparatus shown in Fig. 3, which consists of a testing chamber, one end of which is connected to a force-producing screw and the other to a graduated balance scale. The cast to be tested is placed into the testing chamber and by a slow steady motion of the screw, even pulling force is exerted on the central portion of the cast, and this in turn forces the scale to automatically record the delivered tensile strength. *The maximum tensile strength* is indicated by the breaking of the cast, at a point of least resistance.

(*d*) *Porosity.*

The porosity or the density of the mixtures was obtained by allowing 10 c.c. of air, under normal pressure to pass through a given amount of plaster (cylinders 3 cm. × 3 cm.) after the latter had become thoroughly dry and hard. The time which it took the 10 c.c. of air to pass through was recorded in seconds. Thus a very porous mixture yields a small number of seconds and vice versa.

B. INFLUENCES OF SUBSTANCES ON:

1. *Time of Set.*

The setting time of plaster-of-Paris can be regulated and depends upon certain substances added to the plaster itself or to the water with which it is mixed. The most important of these are chloride of sodium, alum, sulfate of potassium, dextrin and Portland cement. Chloride of sodium, alum, and sulfate of potassium act identically. The amount of these substances added, determine the setting time; this is contrary to general opinion but the tests have shown that a small amount of salt, a 1 percent solution, hastens the set, while a 2 percent solution of the same, retards it to an appreciable degree. Likewise with cement. Starch in small amounts has no effect on the setting time. On the other hand a small amount of dextrin, a 1 percent solution, lengthens the setting time, and a still larger amount, a 20 percent solution, continues to prolong the setting time and so on until the plaster fails to set. In short it may be stated, that sodium chloride and Portland cement shorten the setting time when added in small amounts to plaster-of-Paris and that dextrin lengthens it in direct proportion to the amount added.

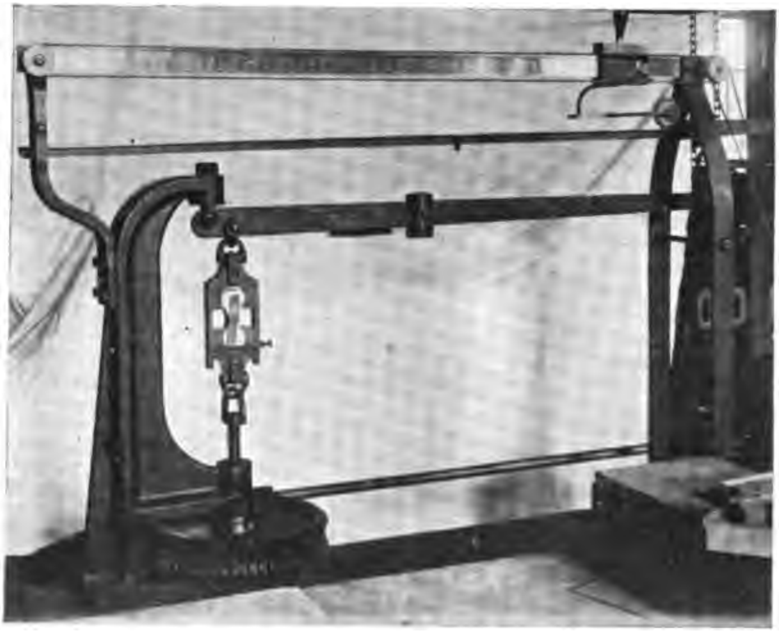

FIG. 3. Showing apparatus used to determine the tensile strength.

2. *Crushing Force.*

The time of set and the crushing force bear no relation to each other whatsoever; often a quick setting plaster appears very hard, but in reality yields a low crushing force and is quite brittle. In the case of chloride of sodium, the crushing force is very low, whereas with dextrin, it is high. Portland cement increases the crushing force to a marked degree.

3. *Tensile Strength.*

Like the setting time and the crushing force, the different substances also affect the adhesion of the molecules of plaster; some diminish it while others increase it. For instance, a small amount of starch (that which is contained in the bandage), tends to increase the tensile strength.* Chloride of sodium and the like diminish the adhesion, while dextrin and cement increase it.

4. *Porosity.*

Whether a plaster dressing is dense or porous is not as important as whether it is strong or weak, but at the same time, other things being equal, we all will agree that a porous dressing is preferable to a dense and non-ventilating one. Sodium chloride gives a very porous dressing, but fails to give the strength. Dextrin gives a somewhat denser dressing, while Portland cement yields a comparatively porous one. Portland cement mixed with plaster-of-Paris shows a greater porosity than either the plaster itself or dextrin and plaster.

III. CRINOLINE.

Crinoline forms the basis of the plaster-of-Paris bandage and may be procured in many varieties. It is a fabric which at first is loosely woven and subsequently stiffened by a process called sizing. It varies in the number of threads to the inch, and in the material used in the sizing process; a crinoline running forty threads to the inch is the best for plaster bandages. The most common and that which is usually found in the market, is the

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*This is probably due to the moisture plus the latent heat generated by the plaster while in the process of recrystalization.

Unicorn brand which runs anywhere from fifty-five to sixty-five threads to the inch; it makes a very poor bandage.

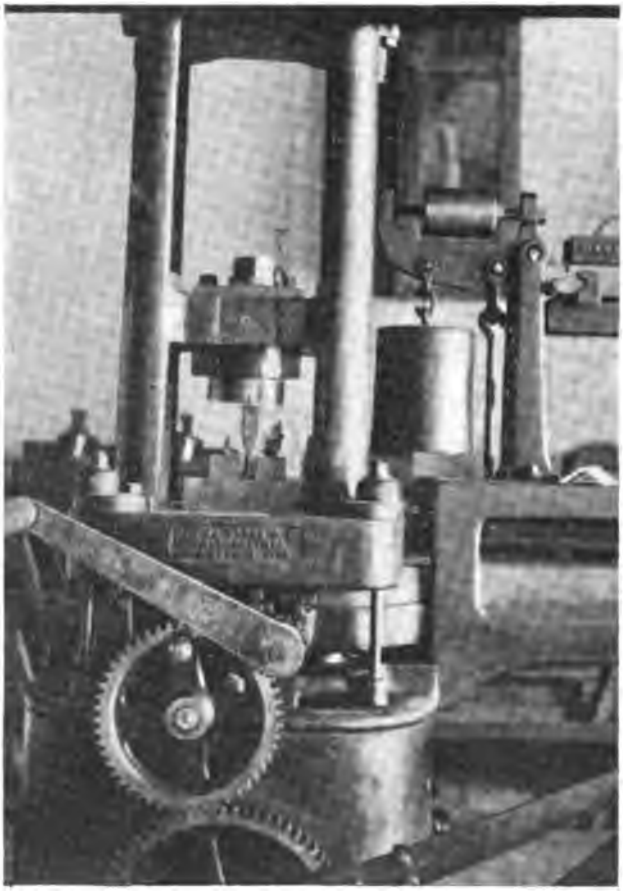

FIG. 4. Showing the Olsen machine with attachment to test the combined crushing force and tensile strength (breaking force) of the plaster-of-Paris bandage.

There are three kinds* of crinoline of the forty-thread make, in general use for plaster-of-Paris bandages:

1. Unsized, or washed,

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*To determine between the dextrin and starch sized, the iodine test may be found convenient.

2. Dextrin, or glue sized,
3. Starch sized.

The tests have shown that the washed or unsized crinoline makes a very weak plaster bandage, having also the disadvantage of being difficult to apply. The dextrin or glue sized contains too much dextrin or glue in proportion to the amount of plaster used, and therefore retards the setting time of the bandage indefinitely. This crinoline should never be used; it is frequently the cause of the reported failures of certain lots of bandages, it often accounts for the complaint of their not setting in a reasonable time, and is also one of the contributing causes of the so-called soft plaster dressing which we occasionally see.

The starch contained in the bandages has no effect on the setting time of the plaster and even tends to increase the tensile strength. The best crinoline of the starch sized variety running forty threads to the inch, is the Vigilant brand and should always be used if a good bandage is desired. This crinoline comes thirty inches wide and twenty-four yards long to that it may be torn in convenient lengths or widths.

IV. The Plaster Bandage.

1. *Material.*

As has been stated above, the best material for the plaster bandage is the starch sized crinoline, in conjunction with the quick setting plaster and in a solution of seventy degrees Fahrenheit. If it is desired to change the setting time of the bandage with dextrin or sodium chloride the substance used should be added to the water and then the bandage immersed. If cement is used it should be added to the plaster as given below. The bandage should be four inches wide, and six yards long.

2. *Preparation.*

There have been many different appliances invented for the preparation of the plaster-of-Paris bandage but all seem to lack the essential feature; that is, to thoroughly force the plaster into the meshes of the gauze. There is, as yet, no better way of preparing the plaster bandage than by hand. The long strips of torn crinoline should be placed upon a smooth ground surface (if you please, a large slab of slate), and with a semi-circular motion of the palm, the plaster is forced into the meshes. After the crinoline has taken up all the plaster necessary for a good bandage, its surface should appear smooth with no surplus of plaster upon it. As portions of the bandage are filled, it should be closely rolled and when finished, the end may be conveniently fastened by an elastic band.

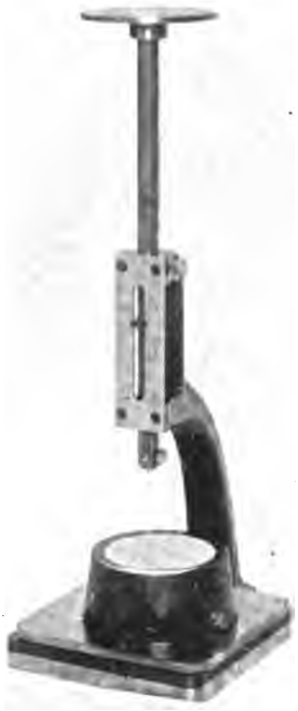

FIG. 5. Showing the apparatus used to obtain the initial, final and actual setting time.

3. *With Portland Cement.*

A small amount of Portland cement added to the plaster-of-Paris before the bandage is made, gives it a great advantage over the pure plaster bandage. As has been stated above, it gives great strength to the plaster by increasing force, tensile strength, and decreasing its setting time and density. It has been found that five parts of Portland cement to ninety-five parts of plaster gives the best results. The plaster and cement should be thoroughly mixed and otherwise the subsequent treatment of the cement bandage is the same with the fine plaster bandage, with the exception that *with the cement bandage, sodium chloride or dextrin* should never be used.

4. *Breaking Strength.*

The real strength of a plaster-of-Paris dressing depends on its resistance to two chief forces which act on its continuity in situ. These two forces are the crushing force and the tensile strength; they act simultaneously and are termed the "breaking" force of the dressing. Therefore, we can readily see that the strongest dressing is the one that will yield the highest average of these two combined forces.

Chart II represents the breaking tests of the plaster-of-Paris bandage, used with the various mixtures.

In preparing the bandages and dressings for the tests, every care possible was taken to guard against mistakes of technique which may take place at this time of the work. Two of these possible errors may be mentioned here; waste of plaster in handling the bandages, thus leaving unequal amounts of plaster, and the lack of securing a thoroughly homogeneous mass in preparing the dressings to be tested. The former was eliminated by placing each bandage in a paper bag as soon as it was made and not disturbing it until ready for use, and the latter by thoroughly rubbing each layer of the moist bandage together so as to insure a firm mass throughout the entire thickness of the number of layers used.

Starch sized crinoline was used in almost all of the tests.[1] The bandages were all exactly four inches wide and five yards long. The quick setting plaster was used with few exceptions.[2]

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[1] See Chart II.

[2] When it was desired to test the slow plaster and compare it with B.

CHART II. BANDAGE TESTS.

Starch sized Crinoline used in all but A. Temp. of solution 70 degrees F.

	Mixture.	Proportion.	Breaking Force of Plaster Bandage.												Total Average.	Remarks.
			Breaking Force in Pounds.													
			8 layers.			10 layers.			12 layers.			14 layers.				
			1.	2.	Average.	1.	2.	Average.	1.	2.	Average.	1.	2.	Average.		
A.	Plaster (washed gauze)	Water	120	135	127.5	180	195	187.5	200	205	202.5	225	230	227.5	186.250	
B.	Plaster (sized gauze)	Water	150	155	152.5	225	200	212.5	255	240	247.5	265	280	272.5	221.250	Standard
C.	Plaster (sized gauze) (not rubbed in)	Water	110	95	102.5	95	125	110	170	178	174	205	219	212	149.625	
D.	Plaster Salt	1% Salt Sol.	105	106	105.5	160	160	160	185	175	180	220	204	212	164.375	
E.	Plaster Salt	5% Salt Sol.	85	100	92.5	105	140	122.5	160	115	137.5	190	202	196	137.125	
F.	Plaster Dextrin	1% Dextrin Sol.	155	175	165	225	205	215	215	237	226	365	345	355	240.250	
G.	Plaster Dextrin	5% Dextrin Sol.	170	190	180	290	280	285	390	390	390	485	475	480	333.750	Sets slowly
H.	Plaster Dextrin Salt	2% Dextrin and 2% Salt Sol.	110	135	122.5	155	190	172.5	245	280	262.5	290	340	315	218.125	
I.	Plaster Cement	Plaster 99 } Water Cement 1 }	150	164	157	225	220	222.5	295	240	267.5	320	340	330	244.250	
J.	Plaster Cement	Plaster 98 } Water Cement 2 }	165	165	165	225	255	240	295	305	300	380	370	375	270.000	
K.	Plaster Cement	Plaster 95 } Water Cement 5 }	180	160	170	275	260	267.5	310	335	322.5	395	395	395	288.750	Sets quickly
L.	Plaster Cement	Plaster 90 } Water Cement 10 }	95	150	122.5	160	184	172	280	265	272.5	340	305	322.5	222.375	
M.	Plaster Cement Salt	Plaster 99 } in Cement 1 } 5% Salt Sol.	170	95	132.5	100	130	115	200	215	207.5	220	230	225	170.000	

BREAKING FORCE OF PLASTER BANDAGE.

	Mixture.	Proportion.	Breaking Force in Pounds.												Total Average.	Remarks.
			8 Layers.			10 Layers.			12 Layers.			14 Layers.				
			1.	2.	Average.	1.	2.	Average.	1.	2.	Average.	1.	2.	Average.		
N.	Plaster Cement Salt	Plaster 98 } in Cement 2 } 5% Salt Sol.	150	140	145	200	190	195	265	240	252.5	270	278	274	216.625	
O.	Plaster Cement Salt	Plaster 95 } in Cement 5 } 5% Salt Sol.	155	150	152.5	210	210	210	280	260	270	280	295	287.5	230.000	
P.	Plaster Cement Salt	Plaster 90 } in Cement 10 } 5% Salt Sol.	145	150	147.5	175	190	182.5	190	230	210	260	240	250	197.500	
Q.	Plaster Cement Dextrin	Plaster 99 } in Cement 1 } 1% Dextrin Sol.	150	120	135	165	180	172.5	260	280	270	275	280	277.5	213.750	
R.	Plaster Cement Dextrin	Plaster 98 } in Cement 2 } 1% Dextrin Sol.	165	180	172.5	185	190	187.5	255	275	265	245	295	270	223.750	
S.	Plaster Cement Dextrin	Plaster 95 } in Cement 5 } 1% Dextrin Sol.	150	135	142.5	195	215	205	310	275	292.5	315	325	320	240.000	
T.	Plaster Cement Dextrin	Plaster 90 } in Cement 10 } 1% Dextrin Sol.	130	170	150	180	170	175	250	270	260	275	280	277.5	215.625	
U.	Plaster Cement Dextrin	Plaster 99 } in Cement 1 } 5% Dextrin Sol.	175	180	177.5	235	225	230	280	275	277.5	360	390	375	265.000	
V.	Plaster Cement Dextrin	Plaster 98 } in Cement 2 } 5% Dextrin Sol.	170	195	182.5	285	200	242.5	265	310	287.5	290	320	305	254.375	
W.	Plaster Cement Dextrin	Plaster 95 } in Cement 5 } 5% Dextrin Sol.	160	150	155	195	205	200	265	290	277.5	270	295	282.5	253.750	

BREAKING FORCE OF PLASTER BANDAGE.

	MIXTURE.	PROPORTION.	BREAKING FORCE IN POUNDS.												Total Average.	REMARKS.
			8 LAYERS.			10 LAYERS.			12 LAYERS.			14 LAYERS.				
			1.	2.	Average.	1.	2.	Average.	1.	2.	Average.	1.	2.	Average.		
X.	Plaster Cement Dextrin	Plaster 90 } in Cement 10 } 5% Dextrin Sol.	120	160	140	215	200	207.5	245	285	265	285	295	290	225.625	
Y.	Plaster Cement Dextrin Salt	Plaster 95 } in Cement 5 } 2% Dex. and 2% Salt Sol.	155	150	152.5	255	260	257.5	275	250	262.5	320	330	325	249.375	
Z.	Plaster Cement Dextrin Salt	Plaster 98 } in Cement 2 } 1% Dex. and 1% Salt Sol.	170	105	137.5	190	195	192.5	245	265	255	290	290	290	218.750	
AA.	Plaster Cement Dextrin Salt	Plaster 90 } in Cement 10 } 1% Dex. and 1% Salt Sol.	100	115	107.5	180	180	180	245	230	237.5	275	295	285	201.500	
BB.	Plaster (slow) (coarse)	Plaster in Water.	155	180	167.5	195	255	225	265	300	282.5	370	350	360	258.750	
CC.	Plaster (slow) (coarse)	In 5% Salt Sol.	95	105	100	210	204	207	220	230	225	280	285	282.5	203.625	

B. Chart II was used as the standard.

Plaster slabs of different thickness were made by winding the bandages upon bottles and then cutting these cylinders before they had set, and placing them flat upon a board. After these became hard, they were cut down to the exact size of 3×5 inches (Fig. 1, c). The breaking strength of these slabs was recorded by placing the apparatus, shown in (Fig. 1, d) on the platform of the Olsen machine; the slabs being previously placed between the parallel uprights, and the Olsen machine then operated in similar manner as related in testing the cubes of plaster. As soon as the slab refused to carry the load, the breaking strength was recorded.

5. *Technique of Application of the Bandage.*

The technique of applying and manipulating the bandage are the same for both the pure plaster bandage and the cement bandage. Having prepared the proper bandages for use, they should be placed longitudinally into the solution which should be as near seventy degrees Fahrenheit as possible. They should not be placed upon their ends in the solution, because gravity and the air-bubbles formed will cause the plaster to settle to the lower end of the bandage; this will result in an unequal distribution of plaster. The bandages should be allowed to remain in the solution until the air-bubbles have ceased to rise. On removing the bandages from the solution, each end should be firmly grasped with a hand and squeezed so that no plaster can escape.

As the bandages are used, they should be handed to the surgeon, each in a consecutive drier condition than the preceding. This assures a homogeneous set of the entire dressing.

In the process of application, the bandages should be unrolled twelve or more inches, and these strands of unrolled bandages conformed to the part with equal pressure. *Each layer should be thoroughly rubbed with the hand as it is applied.* This cannot be emphasized too much because by this procedure the life and strength of a dressing can be increased by at least a third.

Speed in manipulation is an important factor in all plaster work; the plaster dressing should be finished before the actual set has taken place. After the last bandage has been applied, the dressing should not receive any more plaster or water; if smoothness is desired the dressing may be rubbed en masse for a few seconds. The number of bandages to be applied depends on the nature of the part included and the age of the patient; however, it can roughly be stated, that from eight to ten layers are sufficient, except over joints, especially over the hip and knee; over these the dressing should be reinforced, either with the plaster-of-Paris bandage turned upon itself, or by incorporating strips of rattan between the layers of plaster.

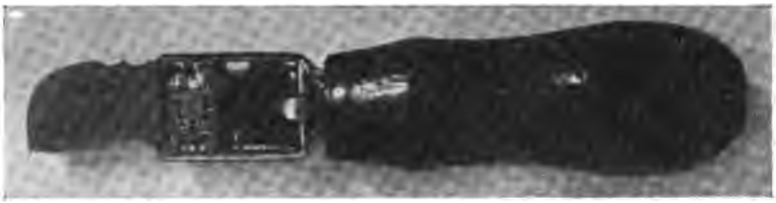

FIG. 6. Showing knife used to remove plaster dressings.

6. *Removal of the Plaster Dressing.*

For the removal of the plaster dressings, many instruments are in vogue, but none that will do the work as well as a knife. Many men condemn the use of a knife for this purpose, but from the writer's observations in these cases, knives that are entirely too long have been used. The knife found to be the best for this purpose is shown in Fig. 6. It consists of a short blade and thick handle, so that the hand may firmly grasp it and that the index finger can completely cover the blade and guide its work. It also has a metallic shield which may be drawn over the blade when the knife is carried in the pocket.

The plaster dressing is first scratched with the knife and then by means of a long pipette, sulphuric acid is allowed to run along this scratch; after waiting a minute or so, the dressing can be cut with ease.

V. CONCLUSIONS.

The essential things of value for a good plaster dressing for practical purposes are:—1. Strength. 2. Quick set. 3. Light weight. 4. Ventilation.

These are brought about and influenced to a great degree by the substances added to the plaster; the knowledge of the action of these will enable us to obtain any kind of dressing which we may desire, and especially to regulate the time of set.

Thus chloride of sodium in small amounts hastens the set; in large amounts retards it; in any amounts it weakens the dressing by decreasing the crushing force and tensile strength. Moreover it weakens the dressing in direct proportion to the amount used. Dextrin in small amounts strengthens the dressing by increasing both the crushing force and tensile strength but it also lengthens the time of set in direct proportion to its use. If the time of set is no object, it may be used to good advantage in certain cases, as for instance in making a plaster bed for multiple tubercular bone lesions. Starch in small amounts (that which is contained in starch sized bandage) adds to the strength by increasing the tensile strength. It does not interfere with the set of the bandage.

Portland cement when used in the plaster-of-Paris bandage has the great advantage over chloride of sodium and dextrin in that it can be mixed with the plaster before the bandages are made and that it materially strengthens the bandage in all of its essentials, i.e., increases the crushing force, tensile strength, and at the same time reduces the time of set and density. The density with it is less than the density of the pure plaster itself. The dressings made of the cement bandage are of a light sage color and are not as easily affected by perspiration. They are much stronger and lighter than the pure plaster dressings.

Plaster dressings are usually fairly well ventilated by the vibrations of the soft parts of the body, yet we often have cases in which this is below par and in hot weather especially, it is of great comfort to the patient to be able to have ventilation to the greatest amount possible. It has been found that if a dressing (a jacket or full spica for example) is made of the most porous material possible, that it can be worn at least twice as long and with more comfort. This fact is well noted in cases where it is desired to retain the same dressing over a long period as is the case in acute Pott's disease, where the future course of the disease often depends upon a long and uninterrupted immobilization of the spine.

In conclusion it may be said that the object of any plaster dressing is to apply as few bandages as possible and still retain the strength which can only be done by using a bandage of the greatest efficiency.

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II.

THE CONSERVATIVE TREATMENT OF HIP DISEASE.

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Before considering the subject properly I desire to discuss briefly just what is here meant by hip disease. The condition here considered is a chronic, usually insidious, destructive disease of the hip, beginning as a rule as an osteitis, and more particularly as an osteitis in, or around the epiphysis of the femoral head, although it may start as an osteitis around the "Y" cartilage in the floor of the acetabulum, and very rarely as a synovitis in the hip-joint; the exact percentage however originating in these various sites I shall not waste time in discussing, as beautiful tables illustrating this point are fully displayed in almost every text-book on orthopedics. I have said a chronic, insidious disease and this is in the main true, yet I have seen a few cases in which, clinically at least, the symptoms were unprovoked, and several in which the symptoms followed directly upon an injury, or so directly, that one could not help noticing some significance of the trauma in the etiology.

While dealing with hip disease in general, my remarks are particularly applicable to the condition as found in children, and will not always be true of the disease in adolescents or adults. While not considering proportions, the great mass of these cases are I believe tuberculous in character and in origin, although my work is leading me to believe that possibly some begin with other infections and subsequently develop the tuberculosis and that a few may, and I emphasize *may*, begin and end without tubercle. I am fully aware that the last will be treated by some of my friends as rank heresy and as beside the question; but so long as these cases cannot always be separated clinically, and in some instances they cannot be in the early stages, and in a few perhaps offer difficulties later, for my purpose, which is the conservative treatment of hip disease, they must be considered together. Especially in young adults the questions of gonorrheal infection and in a few osteo-arthritis, have not always been distinguishable from tubercle; and hip disease has been the best diagnosis that I could make. In children I have sometimes been baffled to decide between tubercle and lues, and have even considered in rare instances the question of both infections at the same time. I am familiar with the aid to diagnosis sometimes offered by tuberculin, but the definite local reaction so ably noted by other observers, has not usually been noted by me, and general reaction, where I have been aware of possibly other foci (enlarged cervical and perhaps bronchial glands), has not always been conclusive; hence while the etiology is not generally in doubt, it happens that I must fain be content with "hip disease" for diagnosis.

Given then a patient with the usual symptoms of lamed function, limp, spasm, interference with the extremes of motion, especially with rotation (in this early stage with these symptoms perhaps intermittent, and with no evident deformity), how can it best be treated to conserve the joint, the limb, the health, and possibly the life? All orthopedic men, and in fact all surgeons, so far as I know, with a single exception, are firmly of the opinion that rest is the essential element; however much they may differ how best this is to be carried out, rest is accepted as the great remedy. Although at different times in the progress of surgery, men have sought quicker roads to fame and wealth, yet ever, as the pendulum swings, have they come back to the safe and narrow path of conservatism, with rest as its foundation.

Early and late authorities, in modern medicine at least, are in full accord as to the value of rest at this stage. Whitman, 2d Edition, page 257, says:—"At one time early operation, even excision, was justified on the plea that the disease might thus be eradicated, but now it is known that in nearly all cases other tuberculous foci exist in the body, and the functional results after these early operations are far inferior to those attained under conservative treatment." Hilton—page 359—"Hip disease is not so commonly scrofulous as supposed, or if scrofulous is curable by rest."

I may say that I have never seen a severe case of hip disease where the patient has not improved by proper rest.

Brodie—4th Edition, page 94—"I have known cases in which rest alone was sufficient to produce a cure. In all cases the symptoms are alleviated by keeping the limb in a state of the most perfect quietude, and this is a very important if not the most important circumstance to be attended to in the treatment." This is about the most positive statement in Brodie, a work written at a time when the most active surgical interference was in absolute sway.

How best to give rest to the lamed joint. The work done by a joint, it seems to me, can be resolved into two forms—motion and weight-carrying, or friction and pressure. Attempts to combat this are made in various ways, and these also can practically be resolved into those which are calculated to lessen or prevent pressure—that is traction (oft called extension) aided by what Whitman calls stilting, during locomotion; and second, immobilization which in its ffiecient application gives rest to motion, or the work due to friction between the joint surfaces. It is to me still an open question whether the rest secured by traction *as usually applied*, or rather, as generally maintained, is of especial value in the majority of cases, except from the immobilization incidentally obtained. While in some instances I am able to secure relief from pain and spasm with properly applied traction, after attempts at immobilization have failed, yet in the majority of cases the reverse has been true; immobilization giving better and quicker relief than traction, and I am feeling that my failures to always get the desired relief were due to my failures to secure the desired immobilization. The tendency of man is to follow the direction of least resistance and when many attempts are necessary before success is obtained, one finds it is much easier to change amounts of traction and directions of pull, than it is to change splints. It has appeared sometimes, however, that after a vicious circle of "spasm, pain, spasm," has been for some time established, that traction has controlled the muscle-spasm more readily than splinting, but this in my experience is rarely the case; better than either, however, in the difficult cases is both—a small amount of traction added to immobilization.

Hilton again says that to favor ankylosis the joint surfaces should be kept easily and steadily in contact—and it seems to me that it is also the best plan to promote repair and favor return to the normal. Gibney: "Whatever ankylosis occurs in a joint subjected to immobilization occurs by reason not of the immobilization but of the nature and intensity of the inflammations and of the inefficiency of the apparatus employed." This observation of Gibney is to me a truism and holds in my opinion in recovery from injuries of joints, as well as from disease.

While arguing that it appears more necessary to limit or prevent motion in the acute stages, I do not wish to be understood as believing that pressure work is of no moment—increased pressure, jars, even the small and repeated traumatisms of locomotion are often badly resented in the acute stages and should then be regularly prevented. It does not appear to me that arguments directed to show that traction of a proper amount applied continuously does lessen pressure in the joint and perhaps separate the joint surfaces, are well chosen in this relation. We are not considering normal pressure, but are dealing with greatly increased jerk-pressure; what older patients describe as spasmodic blows due to the head of the femur being driven into the acetabulum by spasm of the muscles. The spasm is caused by the effort of nature to immobilize the joint, in order to prevent the irritation of motion between the joint surfaces. Immobilization should and usually does control the spasm, prevent the abnormal forcible pressure and secure rest.

Accepting rest as surgically the essential feature in the treatment of hip disease, it is proper to ask what measure of rest is necessary to promote repair. Is absolute rest necessary or even advisable and if so, for how long? Located as the hip is, with the body balanced upon the femoral heads in the erect posture, and the merest sway of the body followed by changes in the position of the joint structures, in fact scarcely a movement of the trunk can be made in any posture without motion in the hip. Absolute rest for any prolonged period is impracticable. In the stages when the disease is active, however, we try to secure rest as absolute as can be obtained, and one naturally adds traction to his attempted immobilization, in an effort to obtain it as nearly as possible. Fortunately, however, this rest absolute is not an essential feature for more than a few weeks at a time and perhaps not at all in the majority of cases. I am being steadily forced to believe that entire freedom from work is not essential, and probably not desirable, as a routine measure over a long period. I doubt whether work in both its phases, and controlled well within the limits of pain and spasm, is not often an advantage except in the very acute stage, or in rapidly progressive cases. Of course one has ever a doubt as to where these limits are, and one naturally tries to confine the work well within the questionable bounds.

Later in the disease I think it probable that motion within the limits of pain or spasm, particularly in a direction away from, or contrary to the natural deformity trend, favors repair and return to functional ability. On the contrary, one should be chary in allowing motion towards the usual deformity positions until convalescence or repair is assured.

Immobilization is attempted in a position of full 180 degrees extension. In the early stages of disease, neither abduction nor adduction is allowed nor rotation inwards nor outwards; later, extension with abduction and control of rotation, but at all times and in all circumstances full extension, is imperative. I am esteeming this position of full 180 degrees extension, as one of the most important features in the conservative treatment of hip disease, and believe that the failure to secure this position is the prime cause of deformity and shortening. It is held by many orthopedic gentlemen that shortening is greater in hips treated throughout by splinting, than in those treated with traction. While this is perhaps true in children when fixation is attempted with the joint more or less flexed, it has not appeared so to me when full extension has been secured. I was led to this opinion originally by noting the direction of the erosion of the acetabulum in cases presenting much shortening which is always backwards, as well as upwards, demonstrating the maintenance of flexion during the cure. Treatment can then be reduced in the majority of simple cases, at least, to immobilization in the full extended position, arranged in such manner as to prevent the usual rotation and adduction deformities and all well within the limits of pain and spasm.

How long is the child kept in bed? The child should only be confined to bed when it appears necessary for its general condition or when it is impracticable to secure local rest, within the given limits, without it—that is, the child is never confined to bed when its general vitality allows it to be up and the requisite rest to the joint can be obtained. Outdoor life is a very essential feature in repair of tuberculous infections, and theorize as we may, under circumstances that is within our control; for practical purposes, a child confined to bed is to a large extent confined to the house, and house dwellers are tubercle breeders. In theory a child confined to bed for the treatment of tuberculous joint lesions spends a great deal of time out of doors, or rests in front of an open window. This is all well understood in theory, but in practice it is usually a farce, and the child's average of full sunlight and free unconfined air is generally very low, even with the best intentions of its parents. Hence the rule, no confinement when symptoms can be controlled without confinement, and the majority of children go to bed nights as healthy children do. I generally have them rest more than other children and lie down for a couple of hours out of doors in the middle of the day, and this is readily secured.

The method of securing immobility and rest is of no importance and must of necessity vary with different men, and their skill with mechanical appliances. I usually use plaster-of-Paris, and ship the children with confidence all over the coast—from Alaska to San Diego—and have at present a girl at each extreme. It subserves a good purpose with me. Ofttimes I use a modified Phelps splint—the material amounts to no more than the paint in a picture, but it is a good splint of whatever style or material it may be when it is applied in such a manner as to maintain full extension, prevent deformity and secure rest sufficient to control pain and spasm. I have devised a plaster splint which answers this purpose to a great extent—its character, its comfort, its approximate cleanliness, its safety, and its efficiency, can be seen in many of the children presented before you. Surely when disturbing symptoms cannot be controlled, with the child around, we naturally confine the patient for a few days or perhaps weeks, until the acute sensitiveness has gone; but at all times the great advantage of outdoor treatment is kept uppermost in mind. So much for a child in whom the disease pursues a simple course.

But what when the case is complicated, as a very large percentage (50 percent to 60 percent in late years) are complicated with abscess? This in my opinion does not call for any especial change in the plan of treatment; the child is allowed to get about as usual—a carefully fitted splint or a bandage gives support to the abscess and the child is watched a little more carefully. If the abscess rapidly increases in size, or is of moderate size and remains for many months, it is aspirated at a point rather remote from the dependent or thinned area. This procedure is repeated whenever necessary, a definite attempt being made in this manner to prevent the ulceration of the abscess, and this succeeds in a large number (in private work about 50 percent), and in most of the remainder, the opening is delayed long enough for nature apparently to erect a barrier between it and the joint, so that when ulceration happens, there is no direct path between the diseased bone and the outside world, and the danger of secondary infection of any extent is not acute. Often in spite of our efforts, the abscess ulcerates and discharges, frequently using as a portal an aspirating puncture, and it may be necessary to keep the child in bed a week or two, to favor cleanliness, to control and confine the discharge within esthetic bounds, than for danger to life or limb. No meddling with the wound is permitted, only sterile dressings (changed often enough to prevent soiling) being used. As soon as the discharge has lessened enough to allow of easy and safe handling the child is up and around, the future history being usually that after a few weeks the discharge gets down to a few drops daily, and within a few months it stops and the sinus closes. Perhaps it may later reopen (but usually if proper care is taken it does not) and the case generally goes on as before, with no doubt more chance of eventual ankylosis.

But when greater destruction is present, when the joint is destroyed, when radiograms show apparently the whole epiphysis has been disorganized and no joint line can be distinguished, when the head of the bone and upper rim of acetabulum have been eroded, when clinically we find the head of the femur on the dorsum of the ilium, and a large abscess complicates the pathological dislocation, when the child has been lying in position of right angle flexion and 25° adduction for weeks, screaming at the slightest movement, surely new resection is necessary. No, even now my experience teaches me that mutilating operations are rarely necessary; that the conservatism that conserves the bone, still offers by far the best chance for recovery with a useful limb. We are in the habit of replacing the head of the femur at the acetabular site, and fixing it there with the leg in *full extension* and about 30 degrees abduction, with a plaster spica. We prefer to establish position at once under an anesthetic, taking time enough to easily secure the 180 degrees extension. In place of the rapid relocation we rarely put the child recumbent, and apply traction in line of deformity, and gradually get replacement by altering line of traction as the tissues yield; but of late years I prefer the rapid relocation at one seance and think I get better position. We then keep the child in bed for a few weeks, changing the splint often enough to keep track of the abscess, and later get the child up and out on crutches. The argument against this procedure is that forcible reposition is likely to open up new paths into the general circulation for tuberculous products. The argument to me is not well taken, for it is very questionable whether so many more direct paths would be furnished by proper force applied for a few minutes only, and followed by approximate rest, than by the slow, and perhaps spasmodic grinding of the eroded head, over the edge of the acetabulum for an unknown period; and again, we are not here considering the disturbing of a healed focus of tubercle, but the better course to pursue when the two surfaces are exposed and perhaps weltering in tuberculous detritus.

I am well aware that advocacy of such a conservative course lays me open in the house of my friends to a charge of being conservative mad, and I am free to admit that such a plan a few years since would have appeared to me unsurgical and dangerous; yet my experience has taught me in the case of small children at least, *that no surgical plan is so bad* and fraught with so much danger, both present and future, *as a plan which holds any radical operation as its base.* Time was when we resected such joints—when we operated early and often, aye long before the children reached the condition now being considered and the remnants of the children who are left haunt us still. The fact is that usually after either of the procedures advocated, the case goes along more or less gently, the abscess gives us later more or less trouble and in two or three years the patient recovers with a very useful although perhaps ankylosed hip. I do not mean to say that all of the children treated in this manner recover. Some children melt down before tubercle, like-well dried tinder before the glowing spark, but I do believe that a far greater proportion get well, and these have longer, abler legs when treated in this manner than when the joint cavity has been invaded and the epiphysis is opened up to risk of infection by the surgeon. A certain proportion die of tuberculous meningitis but I do not know that any larger percent escape this fate after the knife and scoop of the operative surgeon; but of this I am assured, that secondary infections of joints, that open sinuses discharging for months and years, that septic fevers, that amyloid degenerations, that the train of brownie, elf looking caricatures of humanity are more frequent in the wake of operative surgeons than when mutilating operations are carefully eschewed in growing children.

So far I have spoken of conservative procedures in the treatment of children with bone tuberculosis, advocating nonintraarticular meddling in its widest sense as opposed to radical operative plans, as offering the best and safest treatment to conserve life and limb and promote early recovery; but in children of tender years even this aim is perhaps overshadowed by the question of future growth and development.

Several years ago while addressing this society on the matter of the excision of joints I cited a case of a young woman, who had come into my office some time after an excision, wearing a sixteen year old leg on one side and an eight year old leg on the other. This made a decidedly grim impression on me and ever and anon still old excision cases come before me and in the great majority of them, in whom the excision was made in early life, the end result is decidedly bad, both from an esthetic as well as a utilitarian aspect, and the younger the patient at the time of the operation, the worse the termination. In fact, speaking of the result as bad rather feebly expresses the condition found after the lapse of six to ten years. Surely the last end of these patients is worse than the first, and is not to be compared to the end result ordinarily obtained in children who have had the benefit of modern sanitary, careful outdoor treatment for tuberculosis and whose hips have at the same time received efficient protective care.

Why so great difference exists against operative surgery which has made such immense strides along other lines is hard to fully understand. Why an epiphysis which is only interfered with by the contiguity of tuberculous foci, or is perhaps attacked in part by the growth of inflammatory or tuberculous products should still more or less perfectly functionate, or even rarely become stimulated to overgrowth is rarely seen, but why an epiphyseal cartilage, which is so involved and broken down as to be apparently practically separated from the organism by an area of rarified cells, filled with cheesy deposits, or with granular, fatty, yellowish material, with no evident blood supply, why such an epiphysis should be more valuable to the development of the limb, in situ than in vitrio, is not very apparent to me; yet I am firmly of the opinion that the growth of the legs goes on much better with this rotten like head and neck in place, than when it is in a jar. For future growth and development it appears that a disorganized tuberculous epiphysis is far better than no epiphysis.

To what extent should the ultraconservative protective rest treatment be pushed? I am satisfied that it is safe and advisable to a far greater extent than is usual in this country and to far wider limits than I thought possible even three years ago. I have even been seriously asking myself the question of late, whether in the large majority of instances of hip disease in children who are well within the age limits, if it is not the better part of wisdom to refuse resection in all cases, considering the possibility of ablattion, rather than resection, for the cases in which conservative treatment added to general antitubercular treatment had failed. I cannot answer this question positively, but events are transpiring which are sensibly pushing me nearer an affirmative reply; holding closely the belief, however, that the fight is not lost because there is a large abscess in or around the joint and the bone structure has become somewhat disorganized.

Lately there has been offered for your consideration by an earnest, eminent gentleman of this city (and whose very earnestness and honesty makes me timorous in dissenting), a somewhat new operation for the cure of hip disease—a simple procedure, which may however make its advocate great to-morrow. A simple operation, consisting of a mere tunnelling of the trochanter up through the neck into the head of the femur and into the midst of the diffused granuloma; a scooping gently in the dark, and what appears to me to be a mild invitation to the tubercle bacilli to use the tunnelled path and the thing is done. Like the swine in the parable—the bacilli rush down the narrow path into the sea and are choked—in a few days there is a discharge of pus, the tract closes up rather promptly and the child goes on rejoicing, having been saved at the least years of suffering and confinement. The gentleman in support of his contention offers three cases, and however we may differ as to the diagnosis in two of the cases, the third is to me typically a child with tuberculous hip disease and I cannot explain it. If tuberculous (and there was unfortunately no bacteriological nor inoculation experiments as evidence), the tubercle may yet claim its own—time alone can tell. Tuberculous bone in my experience has not acted nor healed in this manner, yet one must not hastily condemn, out of one's ignorance. We well remember how the simple operation of appendectomy, for the cure of the hydra-headed inflammation of the bowels was scouted by many, and when I look back, I wonder at my temerity in opposing the idea. The operation while original with its proponent here, is not exactly new—it was done by many men before, notably by Mc Namara and personally, although I have not performed it, I saw Sherman make the operation at least ten years ago. The merits of a focal operation of any kind versus a resection are very evident. Leaving the matter of interfering with the epiphyseal line out of the question, how is the focal point to be determined? The radiogram in my judgment does not point it out, very rarely can a focus be noted on a plate, but only a diffused cloudiness and loss of outline as evidence of the disease, and not infrequently the process begins in the acetabulum; generally we are not able to distinguish between them, and to cut down on every child who presents symptoms of hip disease and hollow out the head and neck of the femur, interfere with the epiphysis and pave the way for a secondary infection into the midst of a tuberculous infiltration, when at all other times we look upon such a secondary infection as a catastrope to be avoided at many hazards, and all this in a child in whom a focus cannot be located, and which may not be in the femur, and in a child who is winning against tubercle and isolating it, is to me rather serious and dangerous surgery.

III.

THE MECHANICS OF LATERAL CURVATURE.

First Paper: The Mechanical Tendencies of Posture in the Normal.

HENRY O. FEISS, M.D., CLEVELAND.

In this report we are investigating the laws of the tendencies resulting from postural attitudes, the work being a preliminary part of a study of the mechanics of lateral curvature. (The investigation of the mechanical relation of normal posture to scoliosis has very recently been advanced by Dr. Lovett and it is from this work that we get the clew to further study.)

SEGMENTATION AND BALANCE.

In all erect attitudes some effort is necessary to enable a person to stand alone and this effort is afforded by muscular power, but there are certain positions in which the muscular power may be reduced to a minimum and these are obtained by distributing the weight uniformly about a perpendicular line which passes through the center of gravity. (Parow, Horner.)

The body is, however, not a firm mass but consists of segments jointed together, one segment resting upon the other. To prevent the body from collapsing connection between segments must be rendered firm. This is done by tightening the tube of tissues connecting superimposed ones. Then to maintain the erect attitude the line of gravity must pass through the base of support. So in all postures in which balance is maintained there is a constant equilibration by means of shifting segments. (Rimmer, Herman.)

But whether for the sake of balance or not, the result of this segmental movement must mean that the tube of soft parts made up of muscles, fasciæ and integument, and joining adjacent segments is subject to a constant change to tension, so that if one segment moves upon an underlying one, the fact that motion takes place means that the soft parts which connect them must be in greater tension on some sides than on others. So again in the maintenance of an erect attitude which is asymmetrical the tube of soft parts is subject to difference in tension in accordance with the amount of shifting of superimposed segments. In a word, the attainment and maintenance of all positions entails a firm tonicity and tension in those parts of the body in which the segments are most separated. (Zuckerkandl and Erben, Duchenne, Spencer.)

THE MOVEMENTS OF THE SPINAL COLUMN WITH THE THORAX.

If we regard this part of the skeleton in its ligamentous state any motion of the dorsal column must imply a motion of the thorax, for although the spine by itself is an elastic column, its intimate connection with the thorax must give that part of the column a relative unity of action. In the first place the attachment of separate ribs is of such a nature as to render a movement of any one of the upper ten vertebræ impossible without carrying with it a rib, for each of these ribs is attached to a vertebral body and to its transverse process. (Fig. 1.) As each is also attached to the sternum by means of a firm cartilage, then a movement of a rib must imply a movement of the sternum, which again implies

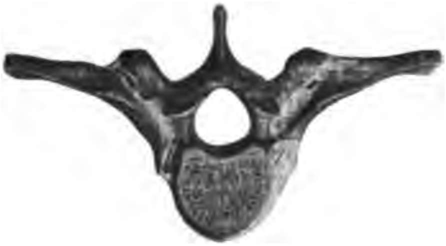

FIG. 1. Fick. The attachment of the ribs to a vertebra, seen from above.

movement of all the ribs attached thereto, for the sternum completes the thoracic basket anteriorly and establishes its unity. The nature of the separate rib attachment to the vertebral bodies is suggestive from another point of view, for the upper ten on each side are attached not to one body but to two adjoining ones, so that the movement of one vertebra by affecting the ribs attached must mean movement of the vertebræ above and below. Finally the intricate fashion in which the ligaments connect the ribs to the vertebræ and the vertebræ to each other must favor concurrent movement in this dorsal region. (Fig. 2.) In agreement with the above facts anatomical evidence shows little lateral and antero-posterior motion in the dorsal region (Guerin, Sappey, Quain, Hess) but most of the authorities (Volkman, Lovett, Quain, Schulthess, Menard and Guibal) agree on some intrinsic rotation theoretically possible here. As a matter of fact, however, the chief point at which rotation is carried out is the very lowest dorsal region, for the presence of the thorax interfering with the

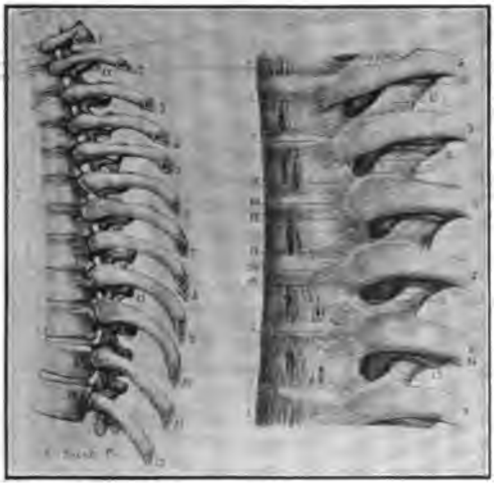

FIG. 2. Sappey's Anatomy. On the left the relation of individual ribs to the dorsal column. On the right the ligaments connecting the ribs with the vertebræ.

individual vertebral movement, it can only take place where the vertebræ have little or nothing to do with the construction of the thorax. These requirements are offered in the region of the 11th and 12th dorsal vertebræ, for the ribs of these two are very short and do not attach to the sternum, they are not connected with the transverse processes of their respective vertebræ, and each is attached to one vertebra only. (Fig. 3.) In the lumbar region there are no ribs to interfere with rotation but the direction of the articular facets makes up for that, so that the only free motion here can be in the sagittal or lateral direction. Moreover the change in the direction of the articular facets between the 11th and 12th is very radical for the lower facets of the 12th face like those of the lumbar vertebræ and the upper ones like those of the dorsal vertebræ. (Fig. 4.) This suggests a sudden change of function and we have to do with movement of the dorsal column

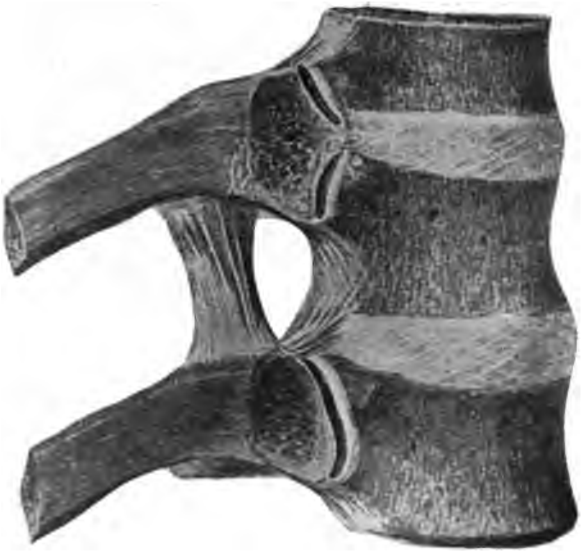

FIG. 3. Fick. The difference between the 10th and 11th ribs in their attachments to the vertebræ.

rather than movement in the dorsal column. Any individual vertebral lateral or rotatory movement which is possible in the dorsal region, except of course in the region of the 11th and 12th vertebræ, is only that dependent upon such play of the vertebral thoracic joints as is exemplified by breathing, but in breathing we think of a relatively fixed dorsal spine and the walls of the thorax moving in unison upwards and downwards by means of the swinging rotatory play of the ribs at the costovertebral joints.

Even if we assume considerable intrinsic movement in the dorsal column, still relatively speaking, we may refer to its segmental motion, and the manner of the thoracic attachment gives this segmental motion a special significance.

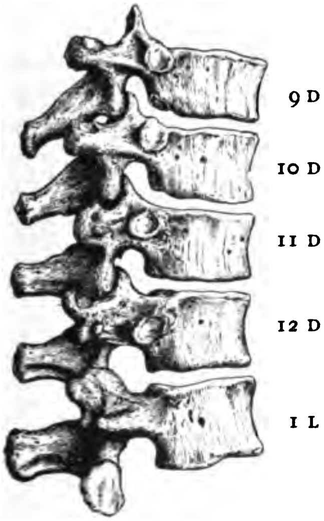

FIG. 4. Quain's Anatomy. 9th, 10th, 11th, 12th dorsal and 1st lumbar vertebræ. Shows the sudden change of direction of the articular facets in the 12th dorsal.

THE TRUNK MUSCLES.

In considering the muscles of the trunk we have based our views upon the conception of G. Herman Meyer (Lehrbuch der

Physiologische Anatomie, 1856) who says, "If one leaves out of consideration the presence of the ribs and sternum, then the whole trunk wall is to be regarded as a cylindrical or sac-shaped tube containing the viscera. The muscles which take part in the

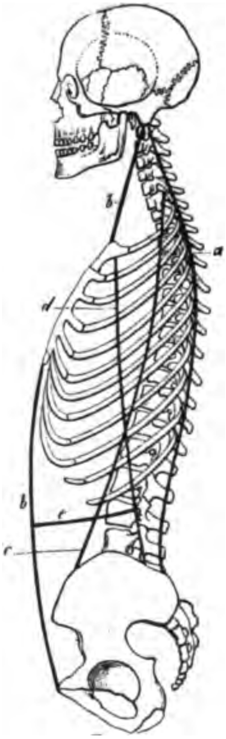

FIG. 5. G. Herman Meyer. The scheme of the trunk musculature indicating the direction of the various muscle pulls. a—posterior longitudinal muscle pull (m. sacrospinalis). b—anterior longitudinal muscle pull. c—oblique descending muscle pull. d—oblique ascending muscle pull. e—transverse muscle pull.

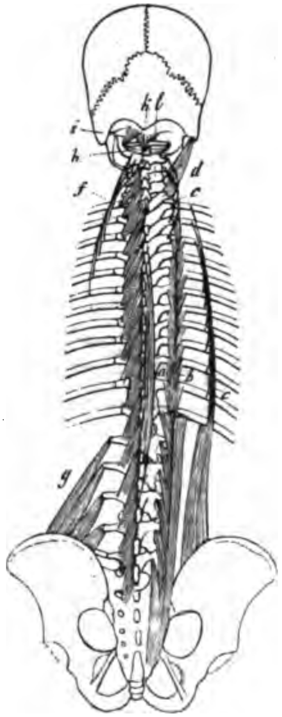

FIG. 6. G. Herman Meyer. The system of the sacrospinalis. a m., spinalis; b m.. longissimus dorsi; c m., transversalis cervicis; d m., trachelomastoideus; e m., ileocostalis; f m., ascendens cervices; g m., ileolumbalis (hinder portion of m. quadratus lumborum Auct.); h m., obliquus capitis inferior; i m., obliquus capitis superior; k m., rectus capitis posterior major; l m., rectus capitis posterior minor.

fastening together of the same can only have the significance of furnishing a resistance against the pressure of the viscera or that of direct pressure on the viscera. In either circumstance this effect must be such a one as would diminish the tube in its diameter.

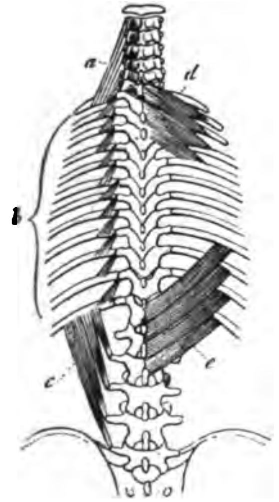

FIG. 7. G. Herman Meyer. The rib muscles. a m., scalenus colli. b m., levatores costarum. c m., scalenus lumborum. d m., serratus posterior superior. e m., serratus posterior inferior.

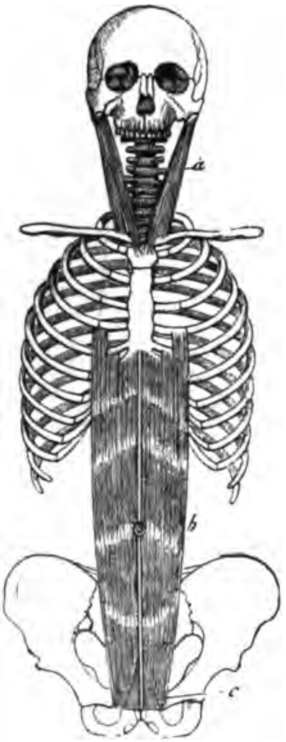

FIG. 8. G. Herman Meyer. Anterior longitudinal muscles of the trunk. a m., sternocleido-mastoideus. b m., rectus abdominis. c m., pyramidalis.

and therewith narrow the space present in the same." In using this system he divided the trunk muscles into five groups (Fig. 5). These are the posterior spinal system, the anterior spinal system, the two oblique systems which cross each other, and the transverse system. The posterior spinal system begins at the occiput and ends at the pelvis. (Fig. 6.) In connection with this system we find a close muscular union of the thorax to the spinal column. (Fig. 7.) The anterior system begins in the neck with the sterno-cleido-mastoid and is continued from the sternum to the pubis in the shape of the two recti joined by the linea alba. (Fig. 8.) As to the two oblique systems he considers the external inter-

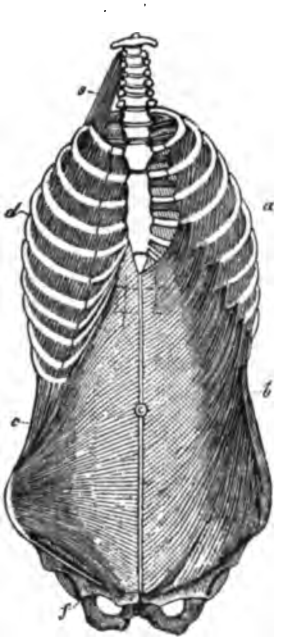

Fig. 9. G. Herman Meyer. The two oblique muscle pulls. On the left the descending oblique. a m., external intercostals; b m., descending oblique or externus abdominis. On the right the ascending oblique muscle pull. c m., descending oblique or internus abdominis; d m., internal intercostals; e m., scalenus colli; f m., cremaster.

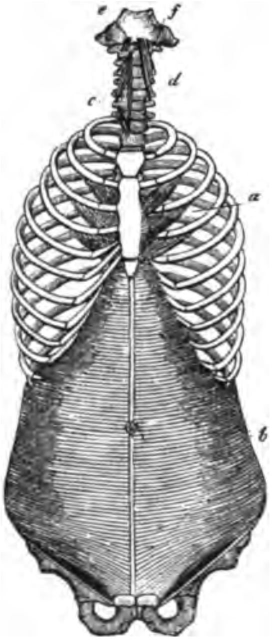

Fig. 10. G. Herman Meyer. The transverse muscle pull. a m., triangularis sterni; b m., transversus abdominis; c m., longus colli; d m., rectus capitis anterior major; e m., rectus capitis anterior minor; f m., rectus capitis lateralis.

costals as continuous with the external oblique and the internal intercostals as continuous with the internal oblique, the difference in the region of the thorax being simply that the ribs form rigid interruptions. (Fig. 9.) The two pulls cross each other. The transverse system is that of the transversalis muscle which encloses the front of the abdomen and bridges across the subcostal angle. (Fig. 10.)

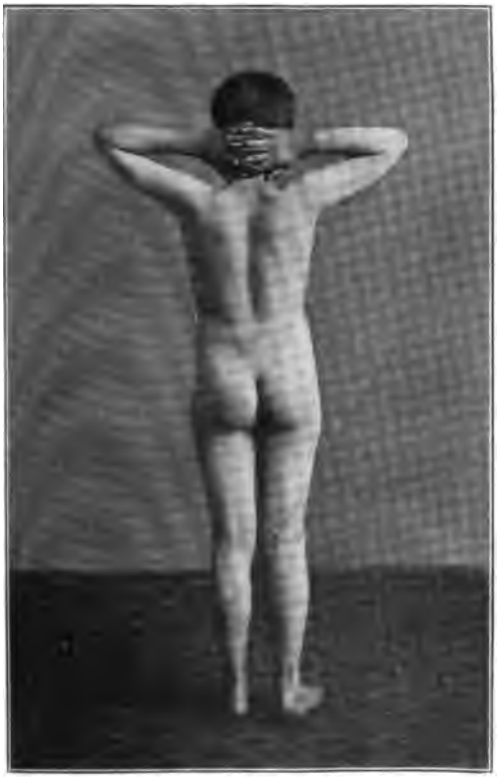

FIG. 11. Normal boy standing erect.

According to this analysis the muscles of the chest are actually continuous with those of the abdomen, the only difference being the insertion of the rib bones in the upper part, so that the practical distinction between abdominal and thoracic parietes is merely one of rigidity. Consequently a pull from any part of this tube will not stop at any particular rib, but will always be communicated

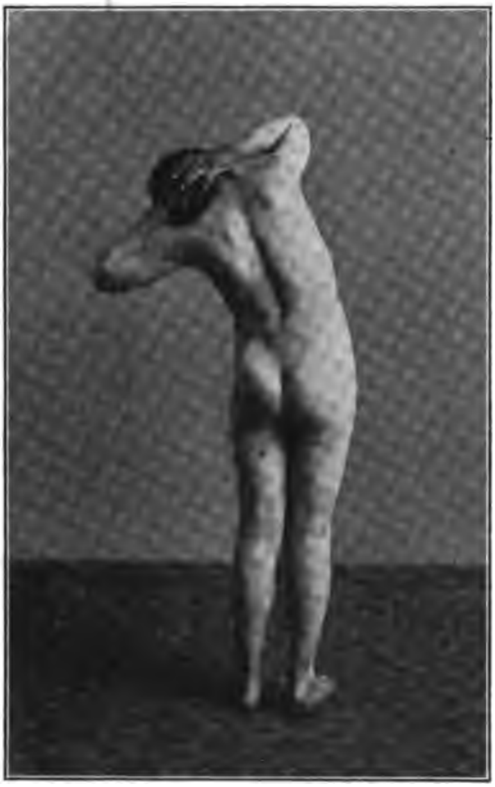

FIG. 12. Normal, bending to left.

to the one above so as finally to exert itself upon the total thoracic wall. (See also Quain, Schulthess, Zuckerkandl und Erben, Duchenne.)

STUDIES ON THE LIVING.

If we seek further interpretation of some of these facts we may resort to photographs of the normal. There are so many varieties of posture that it is very difficult to pick out any especially important one. A pure bend only occurs by coincidence. In the same way with the pure twist. Nevertheless these two postures are perhaps the simplest for purposes of demonstration. It is to be remembered, however, that the camera only reveals integumentary shadows; what goes on under the skin is a matter of interpretation alone.

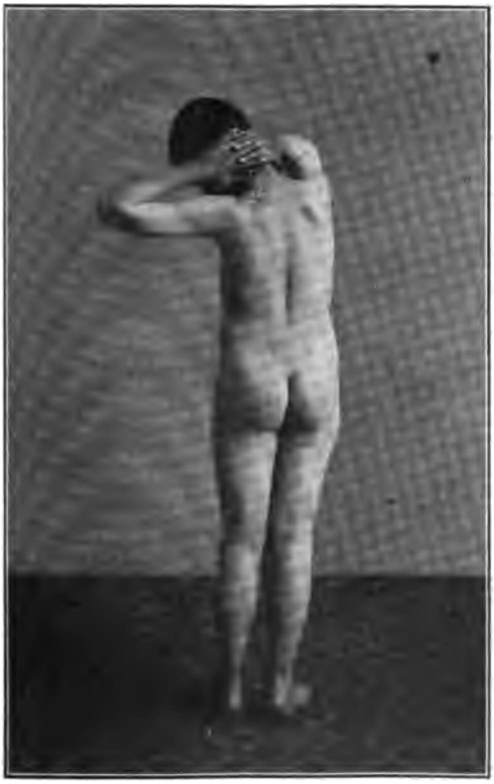

FIG. 13. Normal, twisting.

Fig. 11 shows the normal erect. Fig. 12 shows the effect of a side bend. The segmental movement of the thorax is quite manifest, and it is noticeable that it has swung with its base to the right until it meets the resistance of the lateral factors. The hips are also swung to the right and so also are the knees. The right side of the body is drawn hard and tight, while the left is in folds. In this case which is one of almost pure lateral flexion a sharp bend is noticeable at the dorso-lumbar region. Of course if the point of view had been somewhat to the left, there might have been some apparent dorsal curve. The tension on the right thoracic wall is a direct one, taking place on diametric opposition to the bending column and increasing in proportion to the bend. Fig. 13 represents the twist. The twist begins from the ankles,

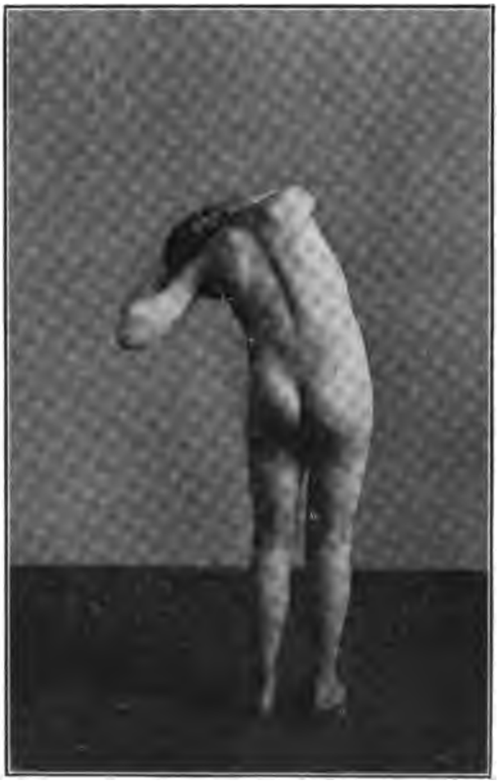

FIG. 14. Normal, bending sideward and forward and slightly twisted.

includes the pelvis, and finally the thorax and shoulders. The soft parts connecting the thorax with the pelvis have become spirally tense. This tension has rotated the pelvis and even affected the knees, showing that the action is communicated from one segment to the other. The tension on the thorax, however, is not a direct one like in lateral bend, for the two forces, the resistance in the ribs and the tightening of the tube, do not diametrically oppose each other. Fig. 14 shows the effect of forward

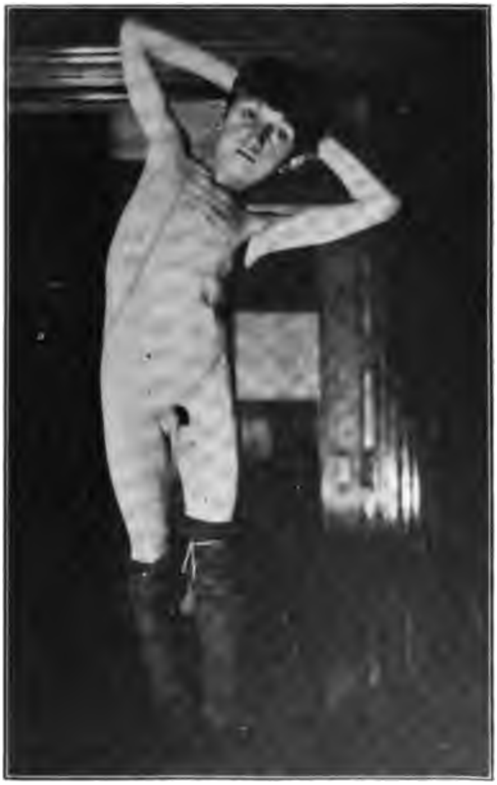

FIG. 15. Normal from in front bending laterally.

and lateral bend with a slight twist, giving the dorsal region an apparent lateral curve. The right pelvis is raised by means of the tightly drawn factors running from the thorax, and the length of the body is greater on one side than on the other. Again the right thoracic wall is under strain. Fig. 15 shows the effect of lateral bend from the front in another boy. The noticeable thing is the pendulum movement of the thorax, swinging as a segment within the tube of tissues with its base to the right and its apex to the left. This being a position of equipoise, segments are balanced over the base of support. Fig. 16 is a composite picture

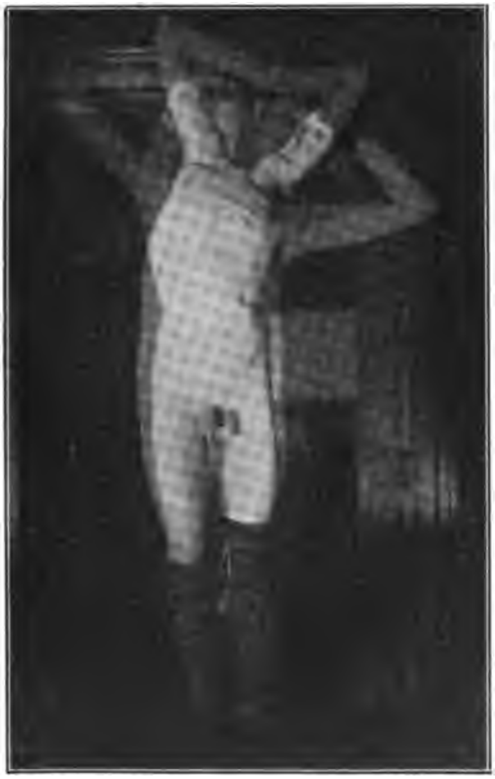

FIG. 16. Composite of erect and lateral bend.

after the method of Lovett, comparing the lateral movements in the previous figure with the erect without changing the foothold or camera. This figure shows the lengthening of the body on the right implying the increased tonicity of the muscles, and as

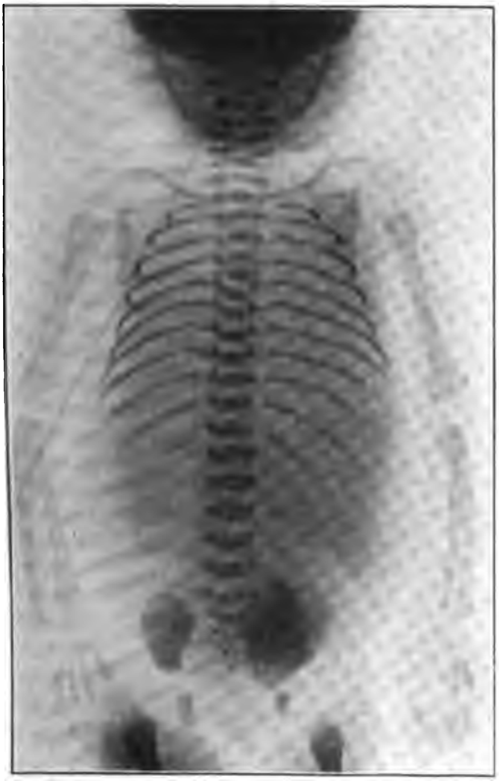

FIG. 17. Röntgengram of fetus laid straight.

Lovett points out the part taken by the entire body in a lateral bend. (Compare with Lovett, Guerin, Volkman, Weber Brothers.)

RÖNTGEN STUDIES.

Fig. 17 shows a fetus laid straight on the negative. It happened that the thoracic cavities were not quite equal in breadth, the right being smaller than the left. Fig. 18 shows the effect of bend to the right. The tension on the wall is so great that the left thoracic cavity, which beforehand was broader, is now become narrower than the other, for the tube of tissues running from the neck to the pelvis on that side being lengthened, is so stretched that the strain coming on the ribs has approximated the side wall to the vertebral column, also it has caused the ribs on that side to separate and to descend, while on the opposite side they are more crowded together. Fig. 19. Twist. The relative distortion in taking such a picture is so difficult to measure that it is

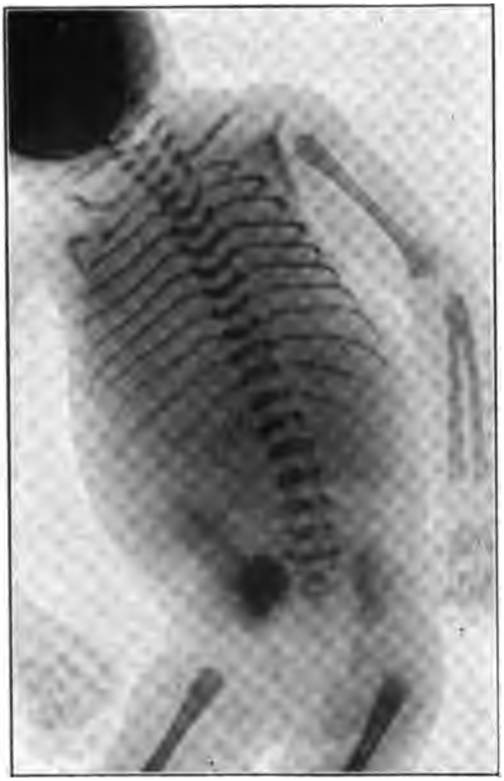

FIG. 18. Röntgengram of fetus bent sideways.

not fair to estimate the size of the thoracic cavities, but the thing which is plain is that the tube of tissues does have at least a little effect upon the bony thorax. Fig. 20. This is a Röntgen picture of a three year old normal living child. The effect here is similar to that seen in the fetus in side bending—namely, narrowing of the thorax on the convex side and separation and descent of the ribs, and crowding on the other. There seems to be some lateral bend in the dorsal column. This is at least partly due to the slight twist accompanying the bend. The maximum bend is however in the lowest dorsal region. Fig. 21. The effect of

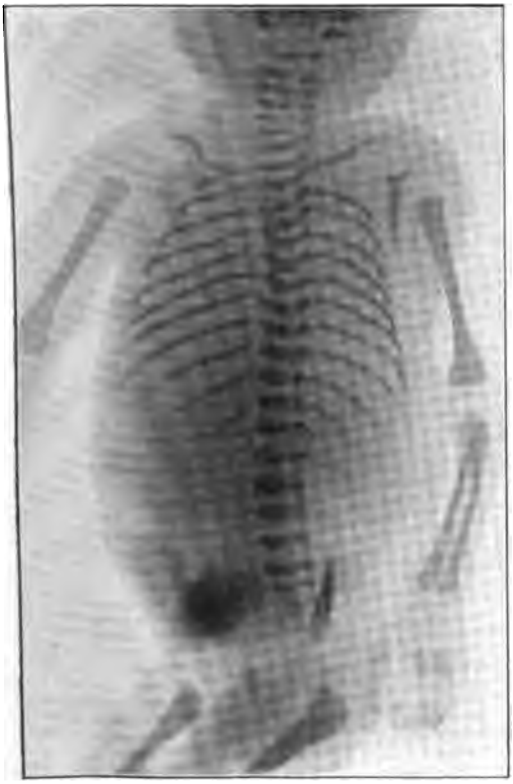

FIG. 19. Röntgengram of fetus twisted.

side bending in a ten year old living boy, and the same effect is once more to be demonstrated.

CONCEPTION OF ARTISTS.

The expression of thought which stands on the highest plane is that conveyed by great artists, but we present the following cuts here less for their scientific value than as a matter of appropriate interest. The artist first conceives and then expresses, and this expression depicts not merely what he observes, but what he thinks, and if he sees no deeper than the skin, yet he tries to realize what is going on beneath. Then by accenting certain contours and shadows he may give us his thought. No camera can do this.

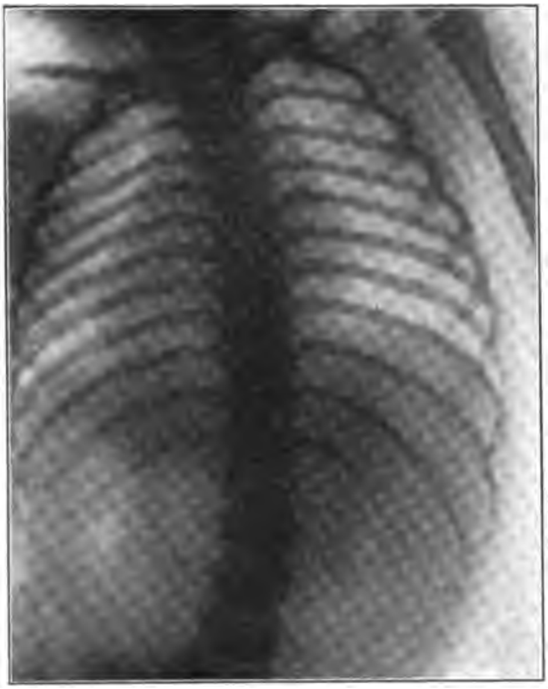

FIG. 20. Röntgengram of three year old living child bent to side.

We have first to do with those artists who studied the physiology of motion chiefly from the living. These were the Greeks, who, having dissected little or not at all, nevertheless gave much time and thought to the human physique, as seen in athletic sports (Duval, Fletcher). Then we have to do with the later schools who based their conceptions, at least to a moderate degree, on their knowledge of anatomy. This group is represented chiefly by Michaelangelo and Raphael, who made great use of their anatomical knowledge. (Critical essays of masters, Ruskin.) Leonardo DaVinci besides his vast anatomical learning made a careful study of the mechanics of motion and posture. (Leonardo DaVinci—Munz's edition, Richter's edition. Extracts from Leonardo's works.)

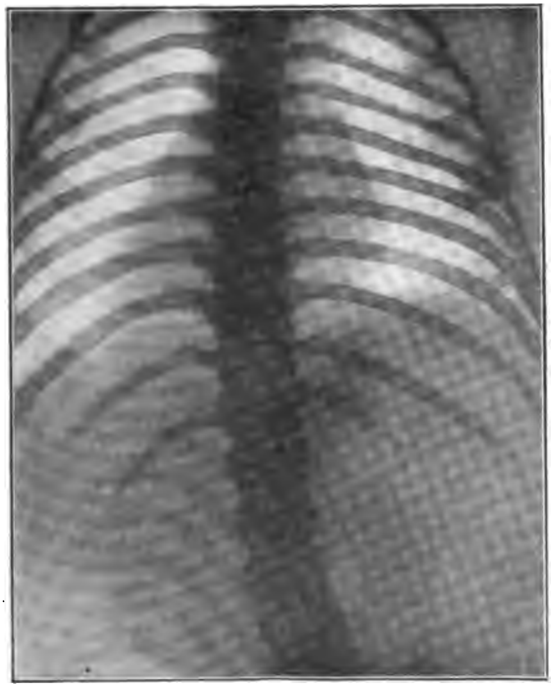

FIG. 21. Röntgengram of ten year old living boy bent to side.

GREEK SCULPTURE.

Fig. 22 from eastern pediment of Parthenon. Postural figure reclining on left thigh and pelvis. The trunk is bent upwards. The thorax is moved as a whole. The left lateral wall of the torso is in a state of extreme tension, straining the left thoracic wall and compressing its sides. The right wall of the thorax is not compressed and even flares out. The mid-thoracic line is practically straight but continuous with the mid-abdominal line.

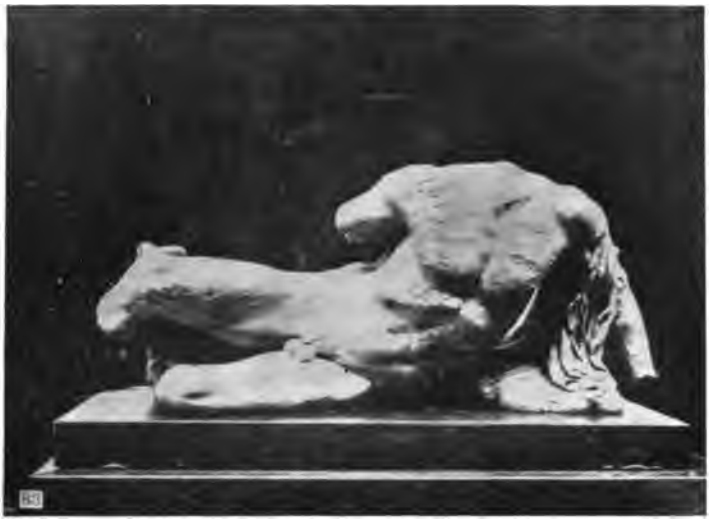

FIG. 22. Figure from Eastern Pediment.—British Museum.

Fig. 23. Laocoon. Middle figure in action. Torso bent to left. Thoracic segment bending as a unity, but with such force as to cause great strain on right thoracic wall. Left trunk shows a fold at the waist line.

Figure of boy in the right of the picture in strained posture. Thorax bent to the left. The strain is upon the right thoracic wall beginning at foot. The waist at the left thrown into folds.

Fig. 24. Farnese Hercules. Postural. The figure rests partly

on support. The thorax has shifted to the left. In this figure the left chest is under pressure and the right is relaxed. The mid-thoracic line is straight and at the ensiform the linea alba diverts from this towards the pubis showing the shifting of the chest as a unity.

The Wrestlers. Fig. 25. Figure on top in action. Trunk bent forwards and thorax twisted, facing to the right. The thorax here has twisted considerably with respect to the pelvis. The total segment has bent and yet the line representing the spinous processes is continuous in a total curve with the lumbar spinous processes. The factors which are thrown into tension are

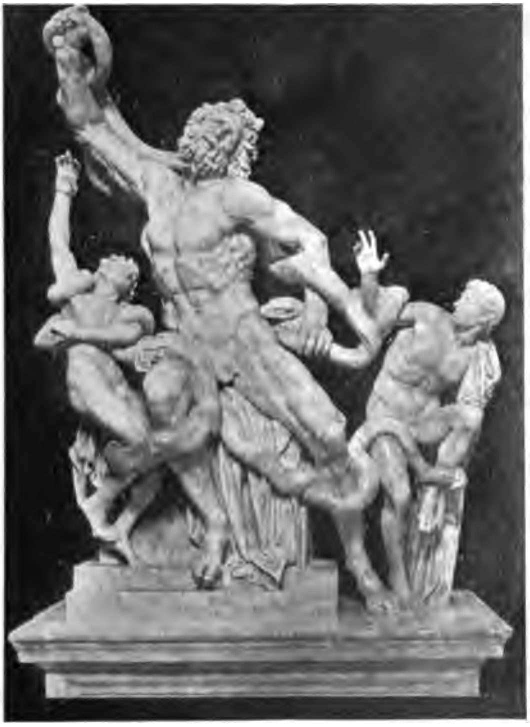

FIG. 23. Laocoon.—Vatican.

those on the right. From the shoulder to the buttocks the whole right chest is under compression owing to the tension. The left waist shows two folds of relaxation. Ribs here are not compressed.

Sketches by Leonardo DaVinci. Fig. 26. The figure in equilibrium and activity. Weight resting on right foot. The line of balance passes through upper part of thorax. Trunk bent to right. Right waist line folded and left side of torso in comparative tension. Fig. 27. Figure on left. Postural. Facing forwards. Weight on left shoulder conveyed into right foot. The thorax bent towards the right, its lower border swinging to the left, throwing into tension the left wall and relaxing the right

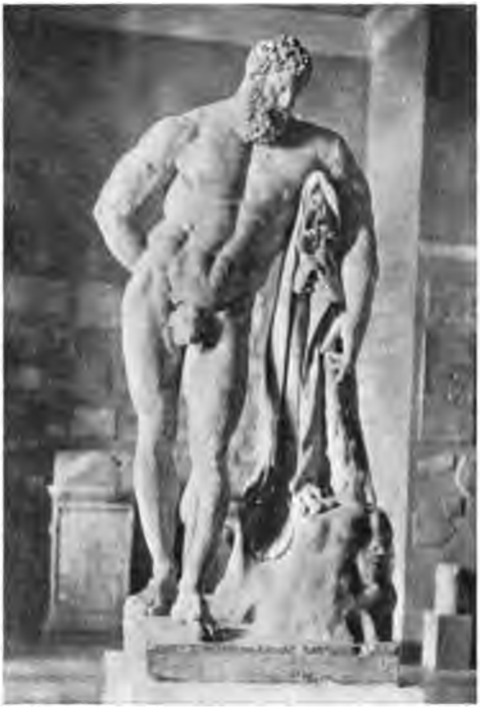

FIG. 24. Farnese Hercules.—Vatican.

waist line. Figure on right. Weight on back conveyed through left foot. Tension doubtful on account of weight-bearing. In both figures the line of balance passes through the pit of the neck. Fig. 28. Figure on left. Figure twisting to the left. Right trunk wall taut. Left waist free. Figure on right. Twisted to the left and bent to left. Right shoulder high. Right and anterior trunk wall tight, apparently compressing right thorax. Left waist in folds. Fig. 29. Postural figure. The line of balance passes through the pit of the neck and weight resting on the left foot and left hip. Trunk bent to the left. Lower thoracic wall swung to right so that the right thoracic wall is under tension, while the waist is folded on the left. The arc from the pubis

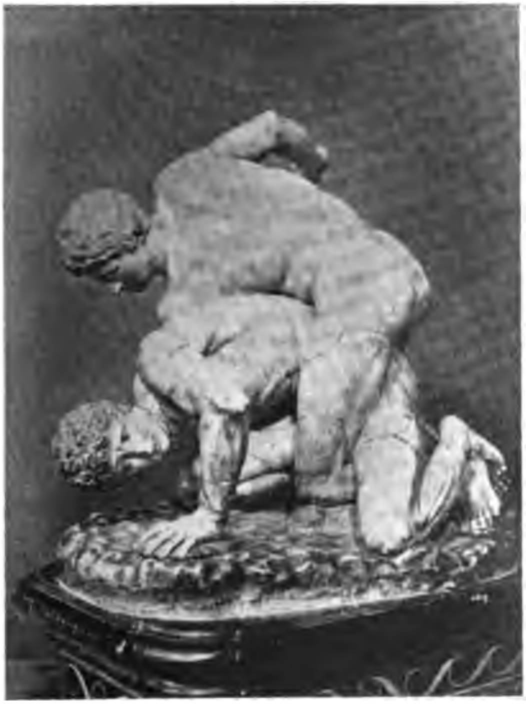

FIG. 25. The Wrestlers.—Uffizi.

to the pit of the neck represents the arc of the folds radiating from an imaginary center to the left of the figure. Fig. 30. Figure in activity. Line of balance through pit of neck. Figure rests on right foot and is twisted to the left. Both trunk walls under tension. Fig. 31. Dancing figure. Line of balance passes through pit of neck. Trunk bent to right and right waist in folds, while left trunk wall is greatly tightened from the foot to

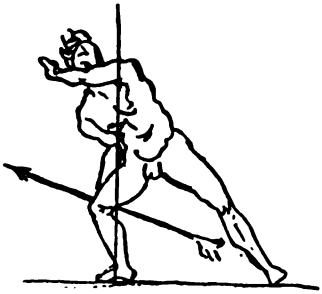

FIG. 26. Sketch by DaVinci. Trattato della Pittura.

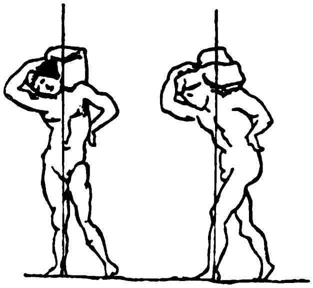

FIG. 27. Sketch by DaVinci. Trattato della Pittura.

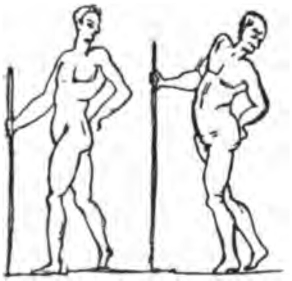

FIG. 28. Sketch by DaVinci. Trattato della Pittura.

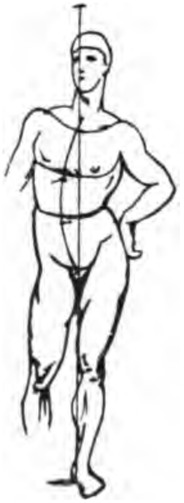

FIG. 29. Sketch by DaVinci. Trattato della Pittura.

the shoulder. Fig. 32. Postural figure. The line of balance through pit of neck. Resting on right hip and right foot. Left torso wall tight. Right waist concave. Thorax swung to left.

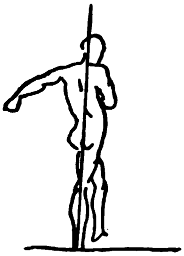

FIG. 30. Sketch by DaVinci.
Trattato della Pittura.

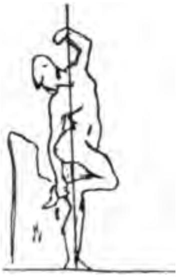

FIG. 31. Sketch by DaVinci.
Trattato della Pittura.

Fig. 33. Dancing figure. Great twist of thorax to the right showing great tension on all thoracic walls.

Michaelangelo sketch. Fig. 34. Figure with back. Shows

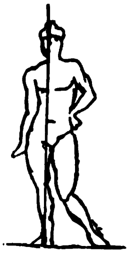

FIG. 32. Sketch by DaVinci.
Trattato della Pittura.

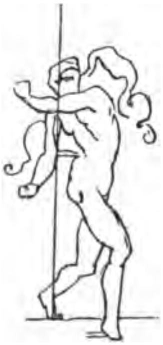

FIG. 33. Sketch by DaVinci.
Trattato della Pittura.

weight thrown on right hip and right foot. The head over right foot. Trunk bent to right from the pelvis. Thorax swung to left. Tightening of left trunk wall throwing right waist into folds. Although the thorax has moved as a whole the mid-spinal furrow has an apparent left lateral curve.

Fig. 35. Raphael. Figure on right. Weight on left foot. Head poised over this. Trunk twisted to the right but bent slightly backwards. Thorax conceived as a total thing. Left waist line considerably relaxed.

Fig. 36. Stuck. Compare with Michaelangelo's sketch.

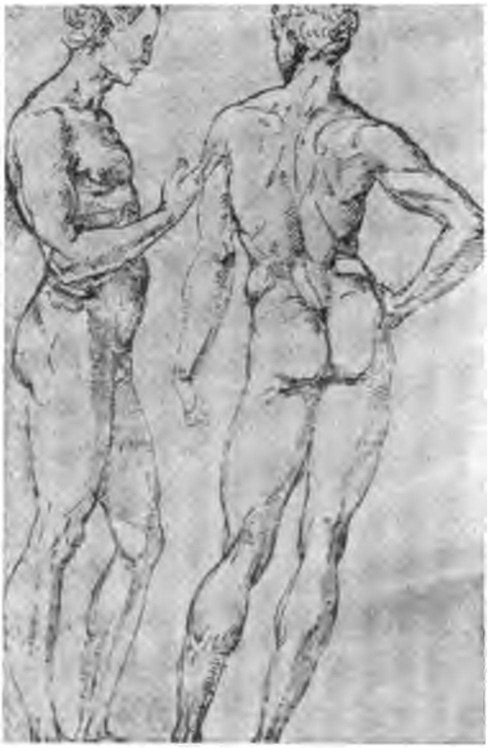

FIG. 34. Study by Michaelangelo.

Thorax here shifted as a total segment upon the pelvis showing tension on left thorax wall and fold at right waist line. The lower border of the thorax has swung to the left.

GENERAL CONCLUSIONS.

THE EFFECT OF MOVEMENT ON THE SOFT PARTS.

The muscular system, the fasciæ and the skin forming an enveloping layer from the neck down to the pelvis, any movement of the trunk must throw a part of this enveloping tube into tension. If, for example, the pelvis is fixed and the trunk bent to the side, then whatever be the primary source of movement, the convex side of the enveloping tube is immediately tightened by the mechanical conditions of separation of the parts. Again if in equipoise posture the head is kept in the same relative position to the feet and the body bent to the side, it must imply a folding of the tissues on the concave side and a tension on the other side of all the factors running from the foot to the head.

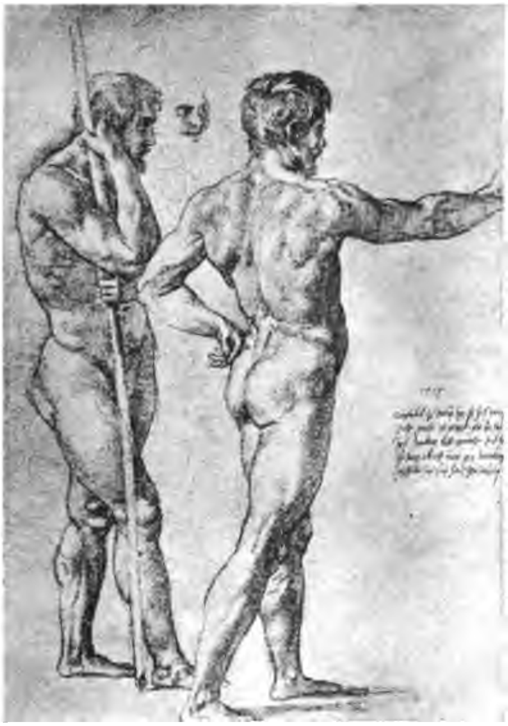

FIG. 35. Study by Raphael.

In a twist, the enveloping tube running from the thorax to the pelvis is strained spirally until it is taut, the pelvis coming with it until brought to a standstill by the muscles, fasciæ and ligaments which hold it to the thighs. The thighs and legs being fastened together by the stiffened knee-joints come still further around on the ankles until the ligaments, muscles and fasciæ around these joints are made firm, so that whatever motion is made and whatever the cause of motion, there is always an element of tension in the soft parts which connect adjacent segments.

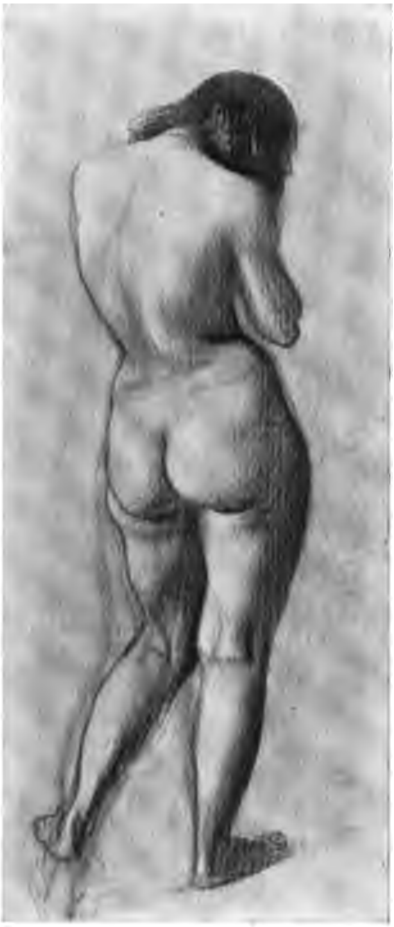

FIG. 36. Study by a recent painter. (Stuck.)

EFFECT ON THE THORAX.

In the thorax the greatest tension must come upon those factors to which this segment owes its maintenance of shape, namely, the ribs. In a side bend the tissues running over the thoracic wall on the convex side are immediately stretched, so that if there is any elasticity in the rib wall they will first give on that side. For as the body lengthens here the muscle wall will tend to approximate the bending column, and the more so in a position of equipoise, which would imply a pendulum motion of the thorax, its base swinging to the side of the convexity. This approximation of the side wall to the column is the important thing, for this means a direct strain upon the interposed rib wall, namely, the posterior part of the thorax in question. The tendency which follows would be for the angles of the ribs to become sharpened on that side. Besides this, on account of the stretching of the lateral wall, the ribs will separate in accordance with the amount of tension, and there will be a downward inclination compared with the ribs on the other side. On the side of the concavity the ribs become crowded together and there is no tendency to sharpen their angles.

In a twist the strain of the muscular resistances is transmitted through the circumference of the base uniformly so that the strain comes upon both halves of the thorax at approximately the same time. This would of course tend to a separation and a descent of the ribs on both sides. The separation of the base of the thorax from the pelvis is not of the same mechanical character as that in lateral bend, for in a lateral bend the direction of the tightening is diametrically opposed to the maintenance of shape of the thorax, while in twist, although the strain may come just as quickly, its direction is not directly antagonistic to the tendency to maintain the shape. Nevertheless there must ultimately be a great strain on the side walls of the thorax as the twisting column drives it through and against the resistances of the encompassing tube and the rows of ribs must tend to change their shape under the strain, although on account of the uniformity of the strain, actual change of shape may be little apparent.

The Effect on the Column.

If the ribs are under strain the effect of this strain must be further communicated to whatever is attached, namely, in this case back into the spinal column. Although the tendency to rib distortion is clear, the effect in the column itself cannot be easily demonstrated on the dead or on the living. In the dead, dissection is necessary, which destroys the normal conditions. In the living the bodies of the vertebræ are too far beneath the surface to permit accurate study. The Röntgen ray meets its limitation on account of the distortion, due to the fact that the rays come from one point. We therefore, will attempt to figure out the effect deductively and on a mechanical basis.

In the first place the region of the connection between column and ribs is the bow of arches and the posterior parts of the bodies of the vertebræ (Fig. 1) and it is in this region that the effect of potential strain on the ribs must first be communicated. The important fact in a side bend is the approximation of the convex wall of the muscle tube to the spinal column or the reverse, tending to narrow that side of the body, so if in side bending the convex thoracic wall comes under strain and this strain is communicated from the ribs back into the spinal column at its posterior part, the row of arches, then while the ribs are sharpening and separating on that side, they must be conveying the strain into the posterior part of the vertebræ, so that this part will naturally tend to give in the direction of the strain; and the spinous processes are pushed in one direction while the fronts of the bodies of the vertebræ are approximating the bent wall in an opposite direction. In other words, while the total dorsal column is moving as a part of the thoracic segment, the strain brought to bear on the ribs is communicated back into the posterior part of the column as a separate tendency of reaction. This reactionary tendency in the column which we may designate as retrograde, is again counteracted in the normal by the firm connection of the anterior and posterior spinal ligaments, and by the inherent tendency of the dorsal column to maintain its unity.

In twisting the principles are the same but the effect is less direct. As a person twists, the soft parts running down the sides of the thorax at the pelvis tighten, but tighten in a direction which is not directly opposed to the maintenance of shape of the thorax, so that we may not note any special local effect upon the thoracic walls. Nevertheless whether the actual shape changes much or not, the ribs do eventually come under strain and in the column itself this strain must fall once more upon the posterior part. Therefore, while the dorsal column is moving primarily with the segment of the thorax, its posterior part must tend to travel in a direction necessitated by the potential strain of the ribs, and this retrograde tendency, as in lateral bend, meets its resistance simply in the cohesiveness with which individual vertebræ are bound together.

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IV.

SOME EXPERIMENTS ON THE MECHANICAL ROTATION OF THE NORMAL SPINE.

From the Anatomical Department of Harvard Medical School.

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This work was undertaken to determine whether or not it is possible with the extremities of the spine fixed, to produce a rotation of any of the intermediate vertebræ and what vertebræ by pressure applied to selected ribs; also to find the most advantageous points for pressure and counter-pressure to produce a given effect. Incidentally the feasibility of fixing the upper dorsal vertebræ by firmly holding the shoulders is shown.

The problem was furnished by Dr. E. H. Bradford for which I am greatly indebted, also for suggestions during the work. Many thanks are due to Prof. Thomas Dwight of the Anatomical Department, Harvard Medical School, for material and interest in the experiments. Without his aid the work could not have been completed

Two cadavers were used, a full term female infant and an adult male of twenty-two years. The viscera were in situ. The sternum of the adult having been split for purposes of preservation was wired. Each subject was laid face downward and bonnet pins were set perpendicularly in each of the posterior spines, of the dorsal, lumbar and first sacral vertebræ. Much difficulty was encountered setting them in the infant spine and satisfactory placing was not secured even after incision of the skin and subcutaneous tissue. The lower extremities were disarticulated and the upper amputated, leaving about one-fourth of the humerus on the torso. The head of the infant was removed.

Fixation of the pelves was attained by transfixing them with long iron pins and then imbedding in plaster. The upper extremity of the infant spine was secured by passing iron pins antero-posteriorly and laterally through the first and second dorsal vertebræ, the ends being engaged in fixed upright (Fig. 1). The first dorsal vertebræ of the adult spine was prevented from rotating by passing a box with a right angle bend at each end over the shoulders at the level of the third dorsal vertebræ and locking back the shoulders with plates passed over the anteriorly projecting ends of the box. From these plates rods extend anteriorly to engage fixed upright (Fig. 2).

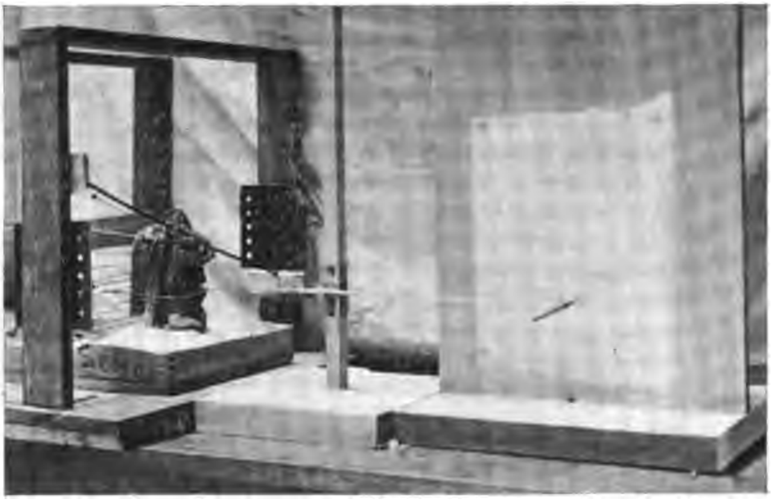

FIG. 1.

The tracings were made by a simple device best explained by the illustrations (Figs. 1 and 2). It consists of an upright board mounted on a base to carry paper and a tracing rod having horizontal and vertical motion on a perpendicular upright. The tracing rod carries a pencil at one end, at the other an angle one side of which is used as a pointer. The two parts are placed in proper relation at the side of the upright torso. The angle at the body end of the tracing rod may be so placed that one side forms a continuation of the rod allowing a tracing to be made of practically in the vertical plane of the rod; but by placing the extreme end of one side of the angle in the slot on the tracing rod, then the end of the pointer side will be five inches posterior to the plane of the rod and a tracing of points in that plane may be superimposed upon the first tracing. All tracings were taken in this manner. The base of the pin is indicated by a round dot and the posterior point by a dot crossed. The difference in the distance of these dots from a given perpendicular is then one side of a right angle triangle the other being five inches which enables one to compute the degrees of rotation.

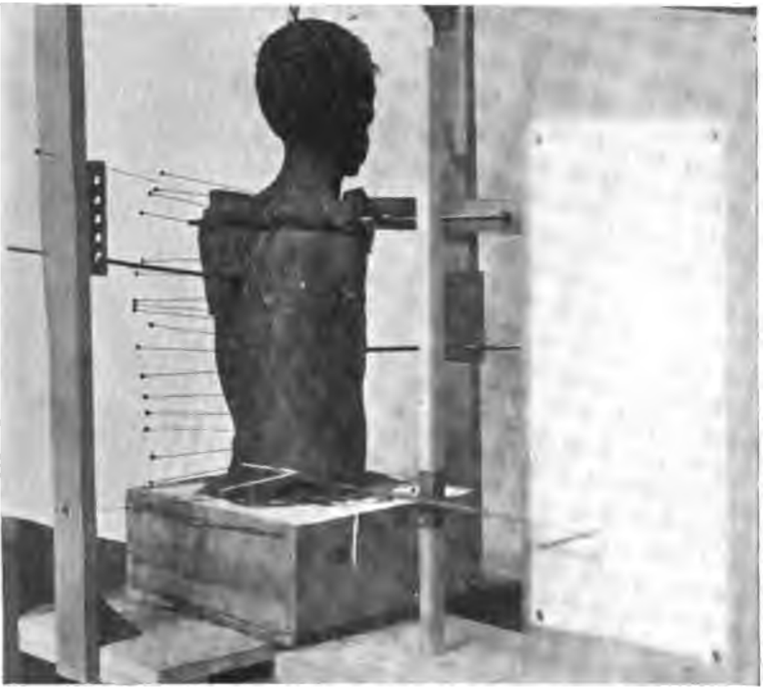

FIG. 2.

The rotations were made on the infant spine by rods having one end bent in the form of three sides of a parallelogram which were used as wrenches. They seemed fairly efficient in the production of rotation but in our endeavor to gain accuracy in judging rib distortion and to localize pressure, they were abandoned in the experiments on the adult for screw-rods finding a fixed point in plates fastened to uprights placed anteriorly and posteriorly to the torso (Fig. 2).

EXPLANATION OF TRACING.

FIG. 3.—Infant spine.

Tracing 1.—Normal—or tracing in two planes of pins as set without attempt at rotation.

Tracing 2.—Rotation backward on the right—with wrench applied at the level of the eighth dorsal vertebra.

Tracing 3.—Reverse of 2. Note ease of rotation of lumbar spine shown by the abrupt low curve.

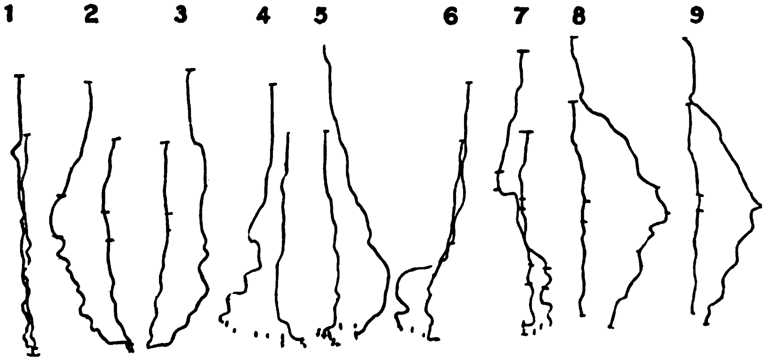

FIG. 3.

Tracings 4 *and* 5.—Rotations right and left at level of eleventh dorsal.

Tracings 6 *and* 7.—Double curves.

Tracing 8.—Rotation left backward with wrench applied at level of ninth dorsal. Twenty pounds pull at a given point (just outside of body line) on wrench handle. Twenty-nine degrees of rotation at tenth dorsal.

Tracing 9.—Same as 8 but with ten pounds pull at the point on wrench handle. The difference in maximum rotation between the two tracings is six degrees.

FIG. 4.—Adult spine. Crosses denote a tracing five inches posterior to plane of the dots and the two marks of each pin are encircled.

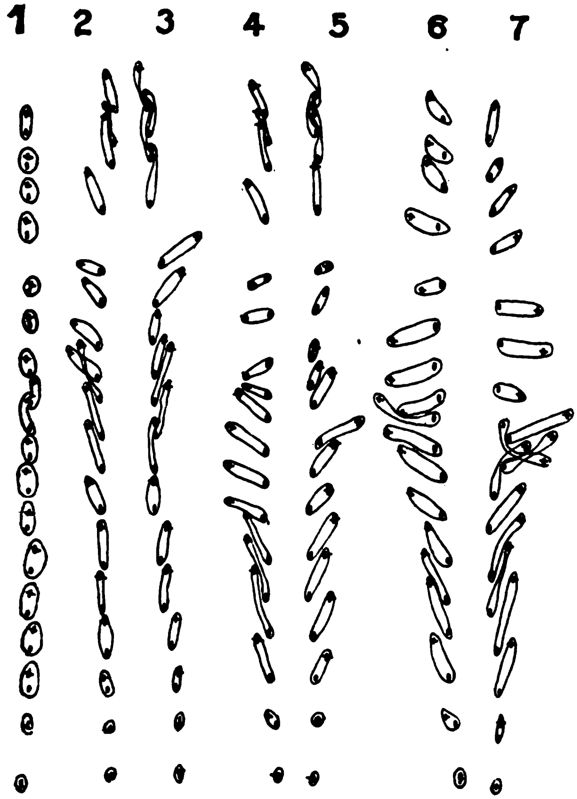

FIG. 4.

Tracing 1.—Unrotated.

Tracing 2.—Pressure in left back and right front on the sixth rib by advancing pressure rods ¾ and 1 inch respectively. Greatest rotation at eighth vertebra.

Tracing 3.—Opposite of 2—greatest rotation at fifth dorsal.

Tracing 4.—Pressure in left back, eleventh rib, and right front on costal margin (low) by advancing rods ¾ and 1 inch respectively. Greatest rotation eleventh and twelfth dorsal.

Tracing 5.—Opposite of 4. Greatest rotation the tenth dorsal.

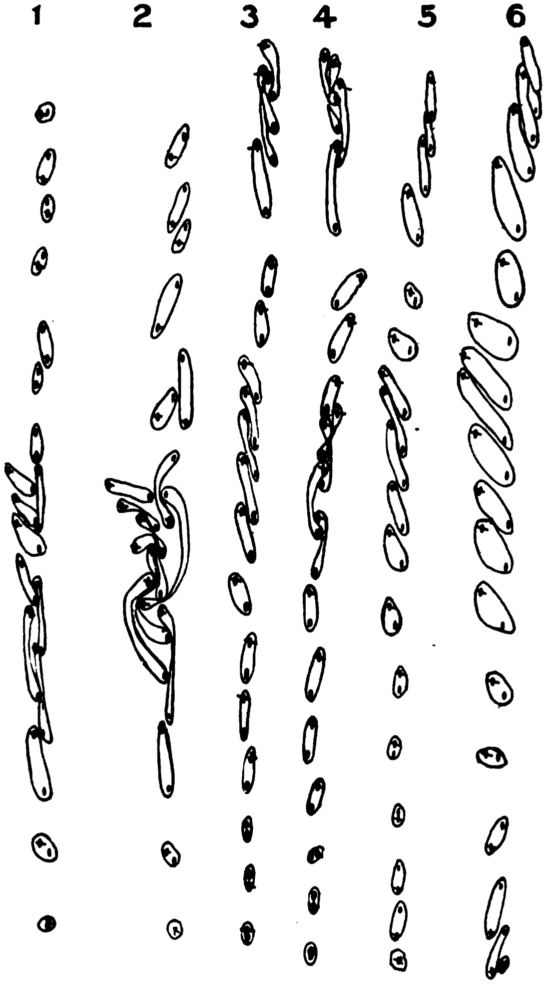

Fig. 5.

Tracing 6.—Pressure in left back on the eighth rib and right front on the costal margin by advancing rods two inches—greatest rotation at ninth dorsal.

Tracing 7.—Opposite of 6. Greatest rotation is at the eighth dorsal. All vertebræ except sacral show some rotation in this pair. That of the first and second dorsal is probably apparent rather than real owing to a slight slipping of the hold on the shoulders from very great pressure.

FIG 5.—Adult spine. Single pressure points.

Tracing 1.—Pressure in right back on the ninth rib by advancing the rod 1¼ inches. The ninth dorsal shows greatest rotation.

Tracing 2.—Same as 1 but with 2¼ inches advance. Note the slight increase in rotation; also the great increase in hyperextension shown by the crosses overlapping.

Tracings 3 *and* 4.—Pressure in front on the fifth rib, right and left. On the left the fifth dorsal shows greatest rotation but on the right the greatest rotation drops to the seventh dorsal.

Tracings 5 *and* 6.—Pressure in front on the costal margin level of eight rib, right and left respectively. Rods advanced 1½ inches and three inches. Difference in rotation nine degrees with greatest rotation at eighth dorsal vertebra.

FIG. 6.—Adult spine. Double curves from four pressure points.

Tracing 1.—Pressure in back on right eighth rib, left eleventh, and in front on costal margin, level of the ninth rib both sides. All rods advanced one inch. Ninth dorsal is unrotated while vertebræ directly above and below are rotated in opposite directions. Note also the slight tendency for rotation to run down into the lumbar spine as in the infant.

Tracing 2.—A similar curve to 1. Pressure in back on right fifth, left eleventh ribs by advancing rods ¾ inch; in front on left fifth rib and right costal margin one inch advance each.

Tracing 3.—An opposite to 2.

Tracing 4.—Pressure in back on left twelfth rib and on right transverse process of second lumbar vertebra.

Tracing 5.—Opposite of 4. The pair show lumbar rotation in slight degree.

Tracing 6.—Pressure on right fifth rib, front and opposite tenth vertebra in right back. Points in same horizontal plane. Rods advanced one inch.

Tracing 7.—An opposite of 6 but with 1⅜ inches advance of rods. Note double curve produced by pressure front and back on same side in the same plane.

ROTATION.

Every tracing taken shows rotation in greater or less degree dependent upon the distance at which the pressure was applied from the fixed vertebræ and the amount of force used. In the

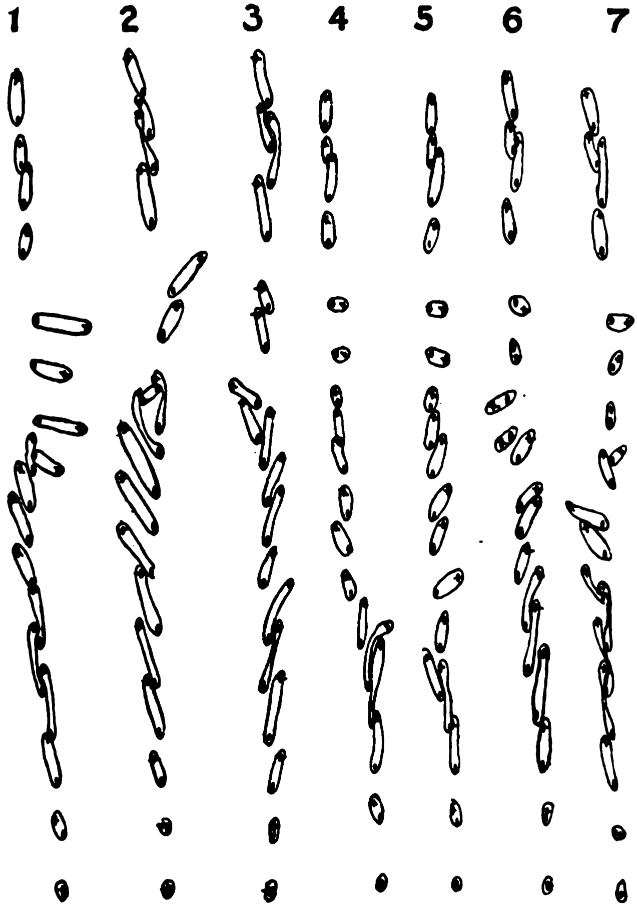

FIG. 6.

infant spine there seemed a tendency for the rotation to run down or to occur most easily in the lumbar region. This however was not so marked in the adult. When a single pressure point was used, the rotation obtained was accompanied by hyperextension or forward bowing if that point was taken in the back and by backward bowing if taken on the ribs anteriorly. Pressure over the sternum as a matter of course was found not to produce rotation but does limit forward bowing when rotation is made by pressure on ribs in the back. The anatomical fact, ribs are lower in front than at their articulations behind, is emphasized by the productions of rotation of the vertebræ in opposite directions by anterior and posterior pressure points on the same side of the torso and in the same horizontal plane. (Fig. 6. Tracings 6 and 7.) All rotations as has been pointed out by Brackelt were accompanied by lateral deviation.

An interesting incident of the experiments was that the adult spine traced straight at the beginning of the work but at the close in spite of endeavors to maintain the perpendicular an unrotated tracing showed a very slight left total curve. It was also observed rotations right backward were more easily produced than those left backward. The vertebræ showing the greatest rotations were in general those articulating with the ribs upon which the pressure was made. However there seemed to be areas in which more than ordinary lose of rotation toward one side or the other was observed. Conceiving these the material is too limited to make statements.

DISTORTION OF RIBS.

It has not been found possible from the present experiments to measure the amount of distortion of a given rib in producing a certain rotation. Owing to the varying amount of pressure needed to rotate different vertebræ dependent largely upon their distance from the fixed vertebræ, the number of pressure pounds seemed of little value, and a definite distance of advance was used. Altogether it is like lifting an unknown varying weight with a lever that springs. But it seems that the one of rotation of the vertebra is seldom more than half the one traversed by the rib in causing that rotation even with the application of moderate force and then as greater pressure is applied the rib bends which makes the discrepancy continue or even greater. Thus in case of the infant spine ten pounds pull on the wrench gave twenty-three degrees rotation, while twenty pounds pull increased the rotation only six degrees.

The adult spine shows nine degrees rotation for each 1½ inches advance in Fig. 5, tracings 5 and 6, the total being eighteen degrees.

PRESSURE.

In applying pressure and counter-pressure the most economized expenditure of force seems found when the points selected are upon the anterior and posterior prominent portions of corresponding ribs, with the exception lowest four ribs. Further the anterior point may be selected on the common costal cartilage where it is at least efficient to limit forward bowing of the spine if not an aid to rotation of the vertebra affected by the posterior pressure.

The importance of a low anterior point is shown by Fig. 6, tracings 6 and 7, and has been mentioned above. This seems of value not only as a matter of economical use of the force employed but disregard of the fact in applying the force could possibly lead to unexpected results as to the vertebræ immediately above those thought to be affected. Pressure on the sternum which has been suggested seems not desirable from there being no aid to rotation at this point. But laterally placed anterior pressure is sufficient in itself to rotate the spine and is almost equally valuable as a block to forward bowing and therefore in our opinion the point of selection.

The method of fixing the upper dorsal vertebræ by locking back the shoulders probably owes its efficiency not only to pull of the pectorals upon the upper ribs but longer to the grasp upon the clavicles and through them upon the upper end of the sternum which fixes the anterior ends of the first ribs and so preventing rotation of the vertebræ articulating with them.

SUMMARY.

1. Rotation of vertebræ may be produced when the extremities

of the spine are fixed by pressure upon any of the intermediate ribs.

2. In general the vertebræ articulating with the ribs on which pressure is applied show the greatest rotation though exceptions occur that are probably characteristic only of an individual spine.

3. Distortion of the ribs occurs in somewhat of a proportion to the amount of force employed after the initial resistance of the rib is overcome. The exact rib—vertebral relation seems to be upset by moderate force—the rotation never equals the rib excursion.

4. The most effective points for pressure and counter-pressure are upon corresponding ribs as far as possible from the mid-line anteriorly and posteriorly, an exception being the anterior point upon the lowest four ribs.

5. Practical fixation of the upper dorsal spine is attained by locking and holding the shoulders in an extreme backward position.

V.

A CASE OF CONGENITAL ELEVATED SHOULDER.

BY E. H. ARNOLD, M. D., NEW HAVEN.

In view of the fact that only a small number of cases of this kind have been reported so far, the hereafter described case may merit description. The patient, a four-year-old boy, apparently in good health, presents himself for examination with the following history.

Family History.—The patient is the last born of a family of thirteen children. All of the children are in general good health, and no deformity, arrest or errors of development have been noticed in them by the parents.

Personal History.—The child has been in general good health from birth, has not had any infectious disease, is fairly strong and active.

History of Complaint.—About eight months ago the child suffered a fall, and as he seemed to have hurt his left upper extremity the family physician was called and diagnosed the injury as a fracture of the clavicle, reduced the fracture and put it up in adhesive plaster dressing usual under the circumstances. Upon removal of the dressing, about five weeks after the injury had been received, it was noticed that the left shoulder was elevated quite considerably. As practically no loss of function followed the injury, no further attention was paid to the condition of the shoulder, until of late the elevation of the shoulder seemed to grow worse, when my advice was sought.

Examination.—The patient is a boy of the development, and of the height and girths becoming to his age. The left shoulder stands about an inch and a half higher, to judge by the soft parts, than the right one. The distance from the spine to the tip of the shoulder is about an inch shorter on the left side than on the right. On palpation the muscles are found firm, but not contracted. The clavicle, supposed to have been broken, shows at this time an absolutely normal condition, by itself and as compared with the right clavicle. No trace of a line of fracture or a callus remains. The shoulder-joint is normal. The scapula seems short and narrow to touch. At its upper and inner angle a bony process projects obliquely fore- up- and outward. The process seems about an inch long and about half an inch wide. It moves sometimes apparently with the scapula; at other times is apparently moved by it. It suggests either an exostoses or a broken or deformed first rib. The first rib can only be palpated with difficulty, and not along its entire course. Pressure on the anterior part of the rib moves the rib slightly, but not the bony process heretofore mentioned, which therefore seems likely to be connected with the scapula. Passive

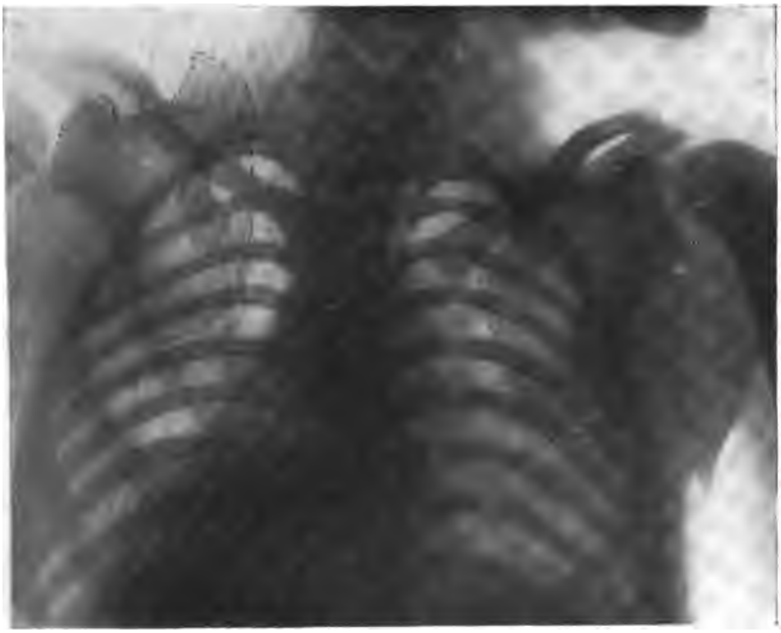

FIG. 1.

and active movement of shoulder-joint and scapula normal. In order to clear up the diagnosis still further, the X-rays were resorted to.

Results of the X-ray Examination (See Skiagraphs).—The skiagraph of the region involved on the left side shows the clavicle to be absolutely normal, and as it shows no line of fracture, thickening or callus, it is extremely doubtful if there ever has been a fracture in this particular location. The scapula of the left side, as compared with the one of the right side, is shown to be in general narrower by ½ inch; shorter by ¾ inch. The lower angle of the scapula of the left side shows less bony development than the one on the right. The bony process felt on palpation proves to be the hook-like process of the angle of the upper and inner border somewhat larger than the one on the right side, but by no means as large as one would be led by palpation to suppose it to be. The upper border of the scapula shows once more lack of bony development, the distance from the upper border to the spine of the scapula being in general smaller than on the right side. This no doubt produces the hook-like character of the angle of inner and upper border. The first rib shows a lack of ossification and development as compared with that of the right side, which is very pronounced at the site of the posterior angle.

Diagnosis.—The X-ray picture leaves no doubt as to the nature of the condition. It is an error of development, a congenital elevated shoulder.

Prognosis.—As the condition had given rise to no trouble and had not been noticed up to the time of the accident, it would very likely have required no treatment and would have remained stationary. The accident and the dressing afore-mentioned seem to have accentuated the malposition of the shoulder, which now seems to have become progressive; and though the spine shows no lateral deviation as yet, the deformity of the shoulder may ultimately produce a lateral curvature.

Treatment.—Mechanical treatment has proven unsuccessful in the opinion of all authors that describe the condition. I propose to resect the hook-like process, or at least its upper extremity, as this seems to engage on the posterior angle of the first rib and thereby prevent the descent of the scapula. As the upper part of the shoulder-blade, the one above the spine, seems to be bent forward at an angle more acute than usual by 10 degrees, I propose to correct this angle by fracture or sub-periosteal division. All this pending three or four months' observation, establishing the fact that the condition is stationary or progressive or whether or not it is causing spinal deformity.

NOTE.—The spinal curve shown on X-ray is due to turning the head to the right and bringing the chin down in order to get unobstructed picture of left shoulder plate.

VI.

SUBTROCHANTERIC OSTEOTOMY IN ADULTS.

ROBERT SOUTTER, M. D., BOSTON.

An attempt has been made not to tabulate brilliant results but to report consecutive cases as they appear. This paper will consider the comparative study of the cases with especial reference to the previous and resulting conditions.

Previous History.—There was no lung disease previous to operation. Most of the cases attributed the back, hip or leg pain to rheumatism. There was only one case of genuine rheumatism. From its description it was probably of the inflammatory type. There were no other constitutional diseases. Excepting the hip disease the general health from

birth to 10 yrs. was good in 13 cases.
10 to 20 yrs. was good in 10 cases.
20 to 30 yrs. was good in 23 cases.
30 to 40 yrs. and over, was good in all.

As to the age at which the disease occurred two cases had hip disease after eight years of age, one at 17 and the other at 12; the rest from 9 months to 8 years of age. The average age including all cases was 5 years; excluding the two over eight years old the average age was 4 years.

The disease did not last over two years in twenty-three cases. In the other two cases one had abscess and sinuses off and on for ten years with intervals free from disease. The other had frequent attacks of disease. It is worthy of notice that only one of these two had what is now considered appropriate treatment for hip disease. The disease was very active with repeated abscess and operation; the disease involved the acetabulun as well as the head of the femur. In spite of this the hip was kept from dislocation. The other cases not having appropriate treatment were all dislocated. The frequency of abscess with sinus was as follows: One case—five times; two cases—twice; thirteen cases—once; nine cases—not at all.

Symptoms before Operation.—The complaints varied from (a) impossibility to stand, (b) pain in back and knee, (c) or leg, (d) difficult walking, (e) lameness, (f) could not sit or walk nor stand, (g) shortening, stiffness, (h) lordosis.

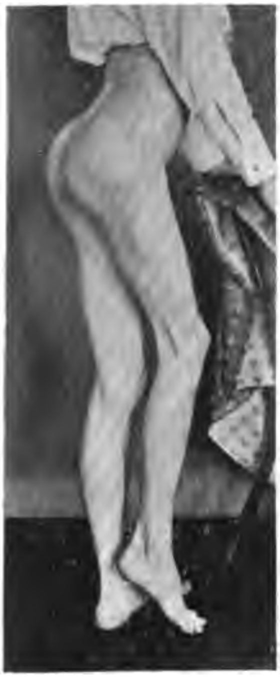

FIG. 1. Before operation. Average amount of deformity lordosis, flexion at hip, short tendo Achilles, inability to touch heel to ground.

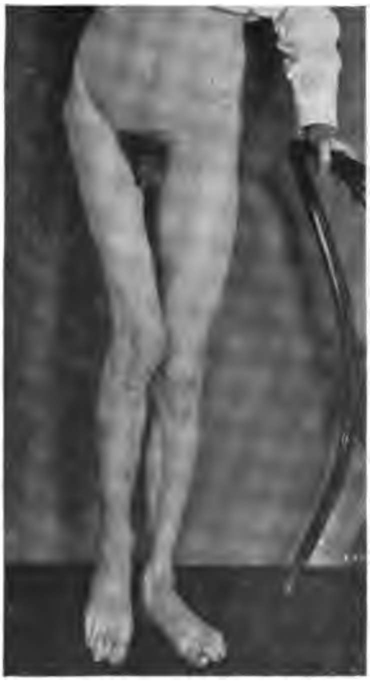

FIG. 2. Before operation Same case—adduction, tilted pelvis, atrophy of the thigh and calf.

Walking and standing were one or both impossible without crutches; painful or difficult in all but four cases. In these four there were periods of from one to three weeks twice or a dozen times a year in which the back or leg seemed to give out. The disability previous to operation in 13 cases had been constant for from nine months to 17 years previous to operation, averaging 14 years.

It is difficult to represent statistically the value of the records. This can be seen from the following:

One case, for instance, had marked pain and disability for two or three weeks every few months for five years. Another had never put his foot to the ground for twenty-eight years. Five others had disability lasting from one to three weeks three or four times a year for seven or eight years previous to operation.

Pain was referred to the knee and thigh, in 3 cases; hip and knee, in 8 cases; hip, in 2 cases; whole leg, in 3 cases; unrecorded, 5 cases.

No two cases had identically the same amount of deformity.

All had adduction and flexion combined with lordosis and either rotation in or rotation out to a deforming degree. The prominent hip being only a sign of the above deformity. The greatest deformity being 55° flexion, 50° adduction and 40° of inward rotation.

Atrophy varied in the thigh from 2 to 5 inches, calf from ½ to 2 inches, shortening from 2¾ to 7¾ inches.

All had short tendo Achilles. Only one could touch the heel of the affected side to the ground without bending the opposite knee. This case was the only one not dislocated. By increasing the lordosis the heel could be brought to the floor.

Local Condition.—Two cases had a few degrees of motion; the others no motion whatever.

Shortening in all but two cases was noticed from the time of the disease, i. e., before eight years old, in the other two at 12 and 17 years of age. Shortening varied from 2¾ to 7¾. Average—4 inches.

High soles though required by all were not worn by five cases. One of these had shortening of 7¾ inches. The high soles varied from 1 to 4½ inches and were all from 1 to 3 inches less than was necessary. It is interesting that the high soles applied by the local dealers were considered by the patient to be from one to two and one half inches less than they measured after deducting the difference between the two shoes.

Operation.—Two cases were operated on for marital reasons on account of adduction. The others on account of disability and pain due to deformity of the hip. Operation was performed from 10 to 35 years after the original trouble and three years after any symptoms that might have been due to diseased bone. One case, however, was operated on one year after such symptoms.

Age at time of operation,

15 to 20 years old	3 cases.
20 to 25 years old	7 cases.
25 to 30 years old	3 cases.
35 to 40 years old	5 cases.
40 to 46 years old	3 cases.

The operation consisted of linear osteotomy because of its advantage over osteectomy being simpler and not entailing loss of bone in an already short leg. At the time of the operation all of the short muscles were thoroughly stretched so that overcorrection could be easily obtained without force. This was considered perhaps as important a point as any other. Additional length was obtained by stretching the short muscles and taking advantage of the obliquity of the pelvis after doing a linear osteotomy. Abduction to nearly 45° without flexion and without outward rotation was the position for the first plaster which extends from the nipples to the toes. The upper edge is cut a little lower behind and on the side of the affected leg. Great care is necessary to maintain this position and to make the plaster fit snugly yet comfortably.

The after-treatment consisted of recumbent position for six weeks, then a short pelvic plaster allowing the knee to bend. After the second six weeks the cases were given back and leg exercises to be continued for six months. Four to six months after operation leather apparatus was worn by one-fourth of the cases at night, nothing being worn during the day.

Local Condition after Operation.—Relative shortening in 23 cases

—0. In two cases, 1½ inches (one of these two had six inches before operation, the other seven and three quarters).

Ultimate position 20° to 25° abduction—no permanent flexion, no lordosis. All legs increased in size after operation, especially the calf of the leg.

In but two cases complications followed the operation, in one case nine months after and in the other five months after. In both the bony union was firm, the position and the resulting length excellent. In the one nine months after the operation the patient had been able to attend to business for six months and was walking very well. An old sinus began to discharge a few drops of pus. This was closed in three months and has remained so ever since.

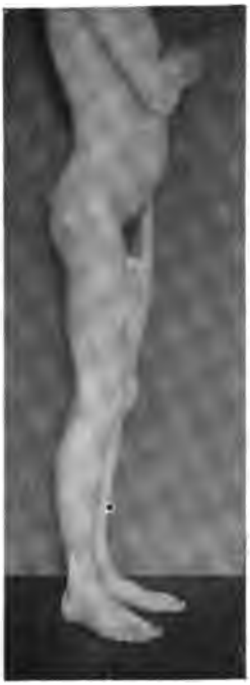

FIG. 3. Two years after operation, same case as Fig. 1. Flat back, good position of hip and ankle.

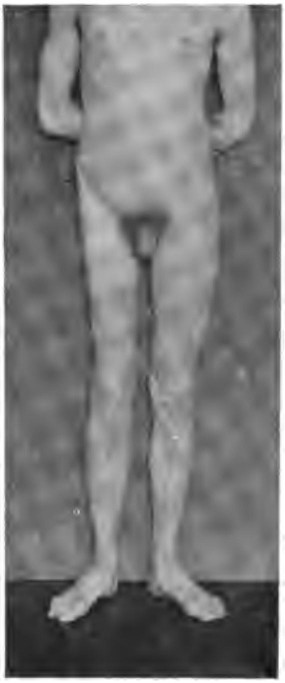

FIG. 4. Two years after operation, same case. Good position of leg; equal size of calf muscles.

He has had no inconvenience from the leg and has never been in better health in his life.

The other case was still wearing a plaster spica at home. She did not call a physician until an abscess discharged at the inner side of the thigh. This was opened and drained and considerable pus evacuated. The bony union was firm and no communication with bone could be found although large counteropenings were made for exploration. The position, length and firmness of union in this case were very good. There was a little discharge from the sinus and her general health and ability to get about is improving. It is now seven months since operation. The abscess was occasioned by the breaking down of an inguinal gland irritated either by the operation or the plaster.

Result of Operation.—There was no pain or discomfort in any case eighteen months after operation. There is one exception to this; the leg was so small and atrophied that there is some discomfort in walking from the weakness in the muscles.

There was no pain or discomfort in some cases three months after operation. On the average in six months the patient was free from all discomfort. Patients could bear weight on the leg without cane or crutches from one and one-half to twelve months after operation, the average being 4 months. Walking was possible in 5 weeks to 10 months; walking was easy at 9–11–15 and 18 months, the average 10 months.

Standing was easy three to nine months after operation.

Occupation was resumed in

3 months	1 case.
5 months	6 cases.
9 months	8 cases.
10 to 13 months	2 cases.
15 months	2 cases.
18 months	2 cases.
Inside of 15 months, but exact time unknown	4 cases.
Total	25

One case developed disease of the lung three years after operation, whether it had any connection it is difficult to say. Friends and relatives thought the patient was too active and overdid constantly as her leg enabled her to do so much.

The health after operation was a great deal better in all other cases.

CONCLUSIONS.

Subtrochanteric operation in adults is very valuable. It was performed in cases averaging fourteen years of disability. The patients from being inactive and unable to walk or stand to any extent were able to be indefinitely active and self-supporting. Not only the local condition is bettered but the general health is greatly improved. The best endorsement is that the patients have been satisfied with the result.

VII.

PERIARTHRITIS OF THE SHOULDER.

Report of Eight Cases.

HOMER GIBNEY, M. D., NEW YORK.

CASE 1.—Laborer, age, fifty-three. *Injury.*—A fall from scaffolding, a distance of 20 feet, striking on left shoulder, resulting in pain, swelling and all motions were restricted. After subsidence of swelling a diagnosis was made of contusion of shoulder.

CASE 2.—Laborer, age, forty-five. *Injury.*—A fall from ladder, a distance of 12 feet, striking left side as he fell; resulting in pain and swelling, bruises or contusion to left hip, fracture of ninth rib, contusion of left shoulder. Repairs were prompt but left shoulder remained the seat of pain extending down arm and forearm.

CASE 3.—Salesman, age, thirty-two. *Injury.*—A fall on slippery street; force of fall apparently moderate, borne by left elbow and hip; elbow remained swollen and sensitive but gradually subsided, when he referred his pain to shoulder and a tingling sensation to arm and forearm.

CASE 4.—Athlete, age, thirty-three. *Injury.*—A fall from swinging rings, striking on his shoulders. The injury seemed slight but he was unable to abduct or rotate his arm without pain and he characterized his pain as a "dull ache" which kept him awake most of the night.

CASE 5.—Seamstress, age, forty. *Injury.*—A fall on sidewalk. No evidence of injury beyond the jar which she felt and she was uncertain as to which side she fell on. That night, however, in her efforts to get into a comfortable sleeping position, she was conscious of an increasing, dull pain in right shoulder, and a consequent restless night and in the morning a numbness of the right arm and hand which prevented her from going to work.

CASE 6.—Hod carrier, age, thirty-eight. *Injury.*—A fall from ladder of six feet. In his descent part of contents of hod and hod itself struck his right shoulder. He thought himself well at the expiration of third day when his right shoulder gave him exquisite pain or as he described it, *twinges of pain and tingling.*

These six cases were treated practically in the same way and responded more or less promptly.

Cases 1, 3 and 5 were thought to be rheumatic as crepitation was present, not only at the shoulder but in the knees and in the case of the seamstress (Case 5) the ankles were swollen and the hands showed enlarged and painful phalangeal articulations.

The two following cases are interesting by contrast as no history of injury or trauma could be elicited. Symptoms exaggerated and recourse to more heroic treatment became necessary.

They were seen by me with Dr. Gibney in his office practice:

Banker, sixty-three; rheumatic family history. Awoke one morning after a restless night, describing his symptoms as a dull indefinite pain at the point of left sholder. Home remedies were employed and the family doctor prescribed salicylates and sling. His pain continued and his shoulder became stiff. On examination two weeks later there was a little noticeable atrophy—inability to rotate or abduct. Careful manipulation showed the scapula and humerus to move together—ankylosis being well established. Under ether the adhesions were successfully broken up, the humerus made to move freely, hot compresses immediately applied and rather gentle massage begun. He stood the manipulation fairly well, when two weeks later, under ether, the same process was gone through with; massage was more easily tolerated and was supplemented by rather frequent applications of the Paquelin thermo cautery. Within two months the functions of the arm were restored and his recovery complete.

The same course of treatment was given Case 8, a doctor's wife, age, twenty-five; who could assign no cause for the increasing dull pain in her left shoulder and numbness of arm and forearm and the subsequent ankylosis. On examination, both shoulders appeared normal; abduction and rotation were limited, however, the scapula moving with the humerus.

Ether was given and the arm fully rotated and abducted, the adhesions forcibly broken up, hot compresses immediately applied, followed by daily massage and frequent cauterizations. At expiration of six weeks patient called and reported recovery of arm to its normal range.

Those who are familiar with the thermo cautery are frequently much surprised at the rapidity or promptness with which its intelligent application dissipates pain, and in our hands, it is a most efficient counter-irritant.

Of the many injuries to the human frame applying for relief at the out-patient department or dispensary of a hospital with an active service, are many contusions of the shoulder which may or may not respond to the routine treatment of the surgical rooms.

Of the last fifty cases applying for treatment at the New York Hospital Dispensary, six have come under my care, referred from the Surgical side. To describe them briefly, the symptoms of one will suffice for the rest.

The acute symptoms have subsided; the evidences of traumatism are not apparent; the measurements of the shoulders and arms are the same and we have limitation of abduction, limited rotation, a sensitive point on deep pressure at the scapulohumeral articulation and sensitiveness on manipulation. Jarjavay first described this group of symptoms as a *periarthritis* in 1867. Later (1872) Duploy reported a series of cases treated by him at his hospital at Beaujeau, one of which came to autopsy. He found the deltoid muscle pale, atrophied and fibrous, the subacromial bursa the seat of inflammation.

The group of six cases treated by me were all the result of an injury as were Duploy's and yielded fairly promptly to treatment which consisted in rather free cauterization, basket strapping with adhesive plaster and instructing the patient in home massage.

I am led therefore to believe with Amidon in his excellent paper that the injury is followed by a circumflex neuritis.

ABSTRACTS.

BOOK REVIEWS.

Precis de Chirurgie Infantile. By E. Kirmisson. *Paris, Masson and Cie,* 1906. Small 8vo, pp. 802, 462 illustrations.

As might be expected from the reputation of the author, this little book is very meritorious. In consideration of the very wide scope implied by its title it is, however, necessarily true that much of the text is simply a repetition of that which will be found on the same subject in treatises on general surgery. To orthopedic surgeons the book is of less interest in its scope than to general surgeons since those parts more properly orthopedic in character are too condensed to be of great practical value. On the other hand, in strictly orthopedic treatises proper account is usually taken of the fact that a very large proportion of the conditions there considered occur in infancy and childhood. It is natural to expect, on this account, that the orthopedic chapters would be less valuable than the others: the discussion of the clinical characters of such conditions as appendicitis, epiphyseal separations, fractures will accordingly be found excellent. There would seem to be an excellent field for a treatise which would aim to dwell upon the variation of the manifestations of surgical conditions in the adult and the child and upon the necessary differences in therapeutic methods. For this purpose this book is believed by the reviewer to be too compendious in its character. In France, where instead of the chair of orthopedic surgery, the medical school is provided with a chair of the surgery of childhood, this book will meet with greater favor than would be the case in America or Germany where orthopedic surgery is for the most part taught as a distinct branch, without particular reference to the age of the patients. While, therefore, we should much prefer this manner of treating orthopedic subjects, as preventing a useless repetition and multiplication in text-books, the excellence of the subject matter in Kirmisson's book is gladly acknowledged.—*Albert H. Freiberg, Cincinnati.*

The Anatomy and Mechanics of Scoliosis. By Nicoladoni, Stuttgart, 1904, Ervin Nägele, Edit.

This book is published after the death of the author and represents all his researches in the mechanics and anatomy of scolioses. The most interesting part is that devoted to the minute changes in the structure of the spine, its ligaments and muscles. One chapter is devoted to the displacements and changes in the viscera. The bones on the concave side are compressed and become dense and on the convex they are less dense. The anatomy, the pathology and the theories of various authors are discussed but there is lacking a clean-cut pathogenesis. In the last chapter the more recent mechanical ideas are discussed. At the end there is a bibliography which is unique in that it is confined wholly to works of German authors.—*Robert Soutter, Boston.*

Technique of Congenital Dislocation of the Hip. By Dr. Calot. *Pub. Masson and Cie*, Paris, 1906.

This book is a sequel to Dr. Calot's book on the "Practice of Operative Surgery." Dr. Calot recommends 15 kilograms of pull on the leg and later performs the operation. Although but 9 cures resulted in the first hundred cases, in the second hundred fifty-three were successful, ninety-seven in the third hundred, and one hundred in the fourth hundred. The method is bloodless with ingenious methods of overcoming obstacles.—*Robert Soutter, Boston.*

PERIODICAL LITERATURE.

Pott's Disease—Forcible and Operative Correction. By Dr. Gormon. *Rev. d'Ortho.*, Paris, Nov., 1906.

The reported case came to the hospital July, 1905, years after the forcible and operative correction which was in 1896 when the child was 7 years old. There was a clear tubercular family history and every evidence that the disease had been Pott's disease. After operation the case was treated continuously for 3 years by the surgeon who had operated and all this time the patient had the advantage of sea air.

At present there is complete relapse. Both legs are flexed, both feet held in slight equinus, the kyphos extends from the third dorsal to the first lumbar.—*Robert Soutter, Boston.*

Acute Osteomyelitis of the Spine. By Latouche. *Rev. d'Orthopédie* Mar., 1906, VII, 2, p. 177.

Report of case in a boy of 14. Prominence of dorso-lumbar region, and abscess. Acute symptoms promptly relieved by evacuation of abscess. Staphylococci in pus. Five days after operation, spine had regained its flexibility, and patient left hospital.—*William E. Blodgett, Detroit.*

A Contribution to the Etiology of "Lateral Curvature" of the Spine. By Max Böhm, M. D. *Boston Med. and Surg. Journal*, Jan. 25, 1906.

The writer reports three cases of idiopathic lateral curvature of the spine in three girls, aged 16, 15 and 23 years respectively, in which X-ray pictures show marked asymmetry of the last lumbar vertebra. He says, "As far as I am able to explain the X-ray pictures the lumbo-sacral region, gives evidence of an anatomical and apparently congenital malformation in the sense of an incomplete development of a sixth lumbar vertebra with more or less fusion to the fifth lumbar vertebra and to the sacrum."

The X-ray pictures are reproduced showing in one case a double transverse process on the left side of the fifth lumbar vertebra and asymmetry in the height of the two sides. Another picture shows asymmetry of the whole fifth lumbar vertebra with possibly fusion to the sacrum. The third picture shows a striking asymmetry of the last lumbar vertebra, with probably an additional pre-sacral vertebra and also possible fusion to the sacrum.

The writer comments upon the fact that this region of the spine has been very little explored by the radiologist, and offers many anatomical difficulties to such study, and suggests that congenital defects or developmental abnormalities in this region may be found to be more common than we have suspected when the subject is more thoroughly studied, as all three of these cases came under his observation in one week. In support of his theory he calls attention to the fact that in the development of man from a lower species "'the ilium travels upward on the spine' (Dwight), a loss of vertebra takes place gradually. The chief places of the spine where this loss or transformation of the vertebra takes place are, according to Rosenberg, the lower lumbar and the lower dorsal regions. These places are also known as the primary places for juvenile spine deformities." He thinks these congenital abnormalities of the vertebræ may be the cause of many cases of lateral curvature.—*J. L. Porter, Chicago.*

More Rapid Correction of Lateral Curvature of the Spine. By Walther Truslow. *Brooklyn Med. Jour.*, Dec., 1905, XIX, 12, p. 445.

Details a method for application of plaster jackets with the patient on a hammock subjected to longitudinal and lateral corrective traction. Webbing straps, in addition to the hammock, fastened at a higher level at the head end of the frame, retract the shoulders. Shoulder straps are incorporated in the jacket, and the front of the jacket is cut out down to the nipples, thus allowing fairly free thoracic respiration without stooping of the shoulders. The summary follows: "Systematic physical training is the main therapeutic agent in the correction of lateral curvature of the spine. Structural changes cannot be overcome by muscular effort alone. Plaster-of-Paris jackets, applied under conditions of progressive longitudinal and lateral traction and frequently renewed, will rapidly overcome muscular contraction, and are advantageously employed in suitable cases of moderate severity. This treatment must be promptly followed by the use of a brace and vigorous physical training."—*William E. Blodgett, Detroit.*

A Simplification of the Removable Elastic Plaster Jacket. By Dr. K. Gerson. *Deut. Med. Woch.*, No. 45.

Gerson described a removable plaster jacket (in *Deut. Med. Woch.*, No. 31, p. 1249) in which two strips of linen with hooks were incorporated in the front and back, in the middle line. The jacket was then split between these, making two halves, which he held together, when on, by elastic bands.

The present jacket is a simplification of the above. In this the strip with the hooks is incorporated only in front, while in the back, a strip of heated moistened linen or muslin, 10 cm. wide is first woven in, then the jacket is cut through to this. After 24 hours a wedge-shaped groove is cut from top to bottom and the edges smoothed; the greater the kyphos the wider the groove must be. After this the groove is moistened with silicate and a piece of cloth heated and moistened in silicate is pasted over it. The upper and lower ends of this strip pass over the edges of this jacket to the inner side and are covered with the stockinet, which lines the jacket. Pads can be placed on the inside of the jacket where needed, to exert greater pressure. The value of this jacket lies in the fact that it can be taken off and put on at will.—*David Townsend.*

Correction of Deformity Resulting From Hip Disease. By Dexter D. Ashley, M. D. *New York Med. Jour.*, March 10, 1906, pp. 481-6.

Methods of correction and bandages applied are discussed in considerable detail and illustrated by 17 photographs. Seven illustrative cases are briefly reviewed.—*G. W. Fitz, Boston, Mass.*

Spontaneous Cure of Congenital Dislocation of the Hip. By Froelich, of Nancy. *Rev. d'Ortho.*, Paris, Jan., 1906.

Dr. Froelich believes that the spontaneous cure of one hip in cases of double congenital dislocation may occur from the fact that the dislocation becomes greater on one side than the other and hence one hip is more abducted than the other. Since adduction favors dislocation of the head, abduction tends to replacement from the direction of thrust. This is in brief his explanation of the two cases he reports both of which had X-rays before and after cure was observed. Dr. Kirmisson has observed a cure of one side in double congenital cases but unfortunately did not have X-rays before the cure took place.—*Robert Soutter, Boston.*

Treatment of Ununited Fractures of Neck of Femur. By Farrar Cobb. *Boston Med. and Surg. J.*, May 10, 1906.

Cobb advises open operation by anterior incision. The ends of the bones are scraped and freshened, and a long steel wire nail is driven through another incision over the trochanter through the neck into the head, under guidance of a finger in the anterior wound. The head of the nail is buried by suturing the lateral incision over it. No drainage is used. A plaster spica is applied from waist to toes. The nail is removed under cocaine in six weeks through a window.

Cobb's patient was able to walk without apparatus in three months. Especial attention is called to the work of Nicolaysen, of Christiania, in nailing these fractures without incision.—*E. W. Ryerson, Chicago.*

The Study of the Clinical Course of Joint Tuberculosis by Means of the X-rays. By Albert H. Freiberg, Cincinnati. *International Clinics*, 1906, Fifteenth Series, IV, p. 139.

A series of case-reports and excellent radiographs in support of the proposition that the X-rays are as useful in the study of the course of joint tuberculosis, as a guide to treatment and prognosis, as they are in initial diagnosis. Diminished definition of bone contour and bone atrophy, often at a distance from the disease, are referred to as radiographically indicative of the progress of the disease. "Surely the study of carefully made X-ray pictures, when used intelligently and in conjunction with otherwise careful clinical observation gives us an opportunity of measuring the progress of our cases and learning what influence we are bringing to bear upon them therapeutically; their value is so great that matters of expense, inconvenience, and technical difficulties to be overcome, are more than counterbalanced."—*William E. Blodgett, Detroit.*

A Contribution to Our Knowledge of Traumatic Foot Affections. Injury of the Tuberculum Majus Calcanei. By Ebbinghaus. *Zentralbl. f. Chir.*, April 14, '06.

Two cases (in adults) of an affection of which E. finds no mention in the literature are described as follows: After a slight injury, pain in the heel came on and grew gradually so severe as to interfere seriously with walking; in Case 1 it was absent when the foot was at rest but not in Case 2: tenderness on pressure was localized over the greater tubercle of the os calcis: no abnormality in position of the foot and no limitation in motion of any of the joints was present; in the X-ray pictures Case 1 presented a spur, projecting from the greater tubercle and showing signs of fracture, while in Case 2 spurs were present on both sides but that on the affected side showed signs that led E. to diagnose a compression fracture. Case 1, being considerably relieved when the sole of the shoe was hollowed out under the spur, refused operation: in Case 2 removal of the spurs gave complete relief. The severity of the pain is explained by the proximity of the plantar nerves and their involvement in the callus. The absence of gonorrhea, the limitation of the affection to one side, the history of trauma, the shape of the spur, and its presence in Case 2 on the sound side serve, according to E., to differentiate this affection from that described by Baer (gonorrheal exostoses of the os calcis).—*David Silver, Pittsburg.*

Tubercular Hallux Valgus. By M. Gaston Cotte, Lyons. *Rev. d'Ortho.*, Paris, Nov., 1905.

This disease was noticed in a patient who died of pulmonary tuberculosis. The toe-joint was diseased on one side and at autopsy an examination was made of the joint and found to be tubercular. A diagram is given of the pathological specimen.—*Robert Soutter, Boston.*

The Relation of Arteriosclerosis to Traumatic Arthritis of the Foot. By Volz. *Arch. f. Orthop.*, Nos. 1 and 2, Bd. IV.

The writer gives a clear definition and description of the various forms of arthritis and shows the influence of infection and trauma in their etiology. Then follows a precise description of the various forms of arteriosclerosis.

Six cases are reported in which after greater or lesser traumatic insult severe pain was experienced in the ankle-joint proper, beneath the Tendo Achillis upon the calcaneus and along the course of the tibial nerve. These parts were swollen, tender and exquisitely painful to pressure and the cases presented the picture of severe arthritis.

Careful X-ray examination in two cases showed atheromatous arteries (clearly seen in the accompanying skiagraphs) together with an osteoporosis of the bones of the ankle. In a third case an amputation had to be performed on account of persistent pain. Dissection showed a condition similar to the first two to be present. In the three remaining cases ordinary therapeutic measures failed to relieve the pain, tenderness and swelling.

CONCLUSIONS.—"Arteriosclerosis can so complicate the ordinary traumata occurring to the lower extremities that the resulting damage becomes irreparable." "The ordinary term arthritis when used to designate such a process had better be replaced by 'osteo-arthromalacia,' because a genuine arthritis is extremely rare under such conditions."—*Walter G. Stern, Cleveland.*

A Clinical and Anatomical Study of Resistant Forward Shoulders. By George W. Fitz. *Boston Med. and Surg. Jour.*, April 16, 1906.

Fitz objects to the term "round shoulders," and instead proposes "forward shoulders." Experiments on the cadaver show that resistance to correction is not due to pectoralis major and minor, but in most cases to serratus magnus. This produces, in addition to forward shoulders, a rotation outward of the lower angle of the scapula. When, therefore, the posterior border of scapula is parallel to the vertebral column, the serratus is probably normal. The coraco-clavicular ligament is sometimes a powerful factor in maintaining the forward position, and in a few cases the clavicle itself seems to impinge against the first rib during efforts at correction. Treatment in cases of the first class is stretching of serratus by spinal braces or by forcible correction with plaster jacket; in class two, subcutaneous division of coraco-clavicular ligament; class three, fracture or division of clavicle at outer third.—*Edwin W. Ryerson, Chicago.*

Joint Tuberculosis. By Dr. M. Patel and Dr. R. Leriche. *Rev. d'Ortho.*, Paris, May, 1906.

Drs. Patel and Leriche report the autopsy and history of a case of multiple tubercular lesions of long standing with complete pathological and histo logical report. The patient was 41 years old.—*Robert Soutter, Boston.*

Open-air Treatment of Bone Tuberculosis at the Wellesley Convalescent Home: With a List of Thirty Permanently Cured Cases.

By E. H. Bradford, M. D., Boston. *Boston Med. and Surg. Journal*, January 18, 1906.

The author describes the out-door treatment of cases of bone and joint tuberculosis for the past three years at the Convalescent Home, at Wellesley, Mass., where provision is made for the treatment of a hundred children, and comments upon the marked improvement in such cases treated there, as compared with treatment of similar cases in the wards of the hospital. In proof of the contention that tubercular bone and joint infections are permanently cured, he cites thirty cases not treated at Wellesley but chiefly treated at homes, which have remained cured from ten to twenty years.—*John L. Porter, M. D., Chicago.*

The Indications for Conservative and Operative Treatment of Joint Tuberculosis.

By Dr. C. Garré, Breslau. *Deut. Med. Woch.*, Nos. 47-48.

Garre begins his article by a general consideration of the subject. He then continues with a discussion of the indications for treatment, both conservative and operative in shoulder, elbow, hand, hip, knee, and foot joint with results. —*David Townsend, Brookline, Mass.*

Fracture of the Neck of the Femur in the Young.

By Hesse. *Ziegler's Beitrage*, 1905. Abst. *Zentralbl. f. Chir.*, Nov. 18, '05.

Five cases of fracture of the femoral neck in the young, 1 to 18 years, are reported from the surgical clinic in Würzburg. In four, X-ray pictures of which are given, the trauma had been slight, while in the fifth its occurrence could not be determined with certainty; the patients all presented the symptom-complex of traumatic coxa vara. The trivial character of the injury and also certain clinical symptoms led H. to the opinion that some local or general condition predisposing to fracture must have existed. The slight functional disturbance following the trauma was striking. Objective changes consisted chiefly in shortening, with elevation of the trochanter, and restriction of motion in abduction and inward rotation. Any tendency to especial localization of the fracture in the region of the epiphysis could not be determined. In one case posttraumatic deforming arthritis developed; in one, early ossification of the epiphysis took place; in two, a considerable diminution in growth of the affected side resulted; in several, persistent atrophy of the thigh and calf occurred. The treatment advocated is very conservative (high sole). A tabular review of 46 cases from the literature, in which the diagnosis was verified by the X-ray or by operation, is given.—*David Silver, Pittsburg.*

The Relative Frequency of Forward Luxation of the Knee in Congenital Dislocation of the Hip.

By Dr. P. Tridon. *Rev. d'Ortho.*, Paris, Nov., 1905.

In the twenty cases reported by Dr. Tridon the deformity is found in both sexes. In double congenital dislocation of the hip of which there were ten the deformity occurred in both knees. In the ten unilateral congenital dislocation of the hip, the luxation of the knee forward occurred on both sides three times, the opposite knee was affected once, the knee of the same side was affected six times. The coexistence of this condition with the hip deform ity does not alter the prognosis or treatment of certain conditions. They should be considered separately and treated as if they existed alone.—*Robert Soutter, Boston.*

Congenital Genu Recurvatum. By Mouchet. *Arch. de Med. des Enfants.*, '05, No. 7. Abst. *Zentralbl. f. Chir.*, Dec. 9, '05.

M. had the opportunity of studying, and making an exact dissection of a case of congenital genu recurvatum in a 4 mos. old baby. The genu recurvatum formed an obtuse angle of 145°; extension could be carried further, as far as a right angle, but flexion was possible only to 180°; the tendon of the triceps stood out anteriorly and the lower end of the femur posteriorly; the patella was present but had no bursa; it lay directly upon a pad of fat which covered the anterior surface of the diaphysis above the trochlea; since, contrary to the observations of many authors, the diaphysis and the epiphysis were not placed at an angle to each other, the cause of the deformity had to be assigned to a congenital dislocation of the tibia backwards, in support of which the author mentions further anatmonical points in the case.

Treatment consists in reduction of the dislocation; the knee being first further extended, the tibia is drawn away from the femur and the head of the tibia then forced backwards under the condyles; the knee is then fixed for a number of weeks, after which massage and passive motion are begun; in many cases reduction is easy, especially if undertaken soon after birth, but in others division of the quadriceps tendon is necessary.—*David Silver, Pittsburg.*

Diagnosis of Flat-foot. By Schüman, Leipzig. *Muenchner Med. Wochenschrift*, Jan. 9, 1906.

It is often impossible, even in pronounced cases of flat-foot, to get a correct idea of the true condition of the arch by examining the foot in a non-static posture. It is advisable to palpate in the weight-bearing position, if one wishes to get the functional height of the arch, and the relation of the malleoli, especially the dropping of the internal malleolus.

The best way to determine the amount of weight-bearing surface of the foot, is to make permanent impressions. The author states the advantage of using this method for records and the help it is in following the treatment. After reviewing the different methods in common use for obtaining permanent impressions, he gives a simple method of his own:—The paper used is thinly coated with a solution of ferric chloride, one half strength, and allowed to dry; it may be used in a fresh condition, but the dry are more conveniently kept at hand. The patient's foot is thinly coated with a 5 percent solution of potassium ferrocyanide and then the patient is told to firmly press the foot upon the paper. A dark blue impression results, which shows the greatest amount of detail, and even shows the papillary lines.

This method is of great advantage because the impressions result in permanent prints which do not have to be fixed, as is the case with the methods in general use.—*Roland O. Meisenbach, Buffalo, N. Y.*

Shoes and Feet. By Robert Soutter, M. D., Boston. *Boston Med. and Surg. Journal*, Jan. 11, 1906.

The author discusses the effect of shoes of various shapes upon feet, and how different kinds of distortion of the feet, ankles and toes are brought about by the wearing of shoes of various fashionable shapes. He shows how apparently slight faults in a shoe interfere with the normal action of the muscles and joints, and proposes certain general changes in the manufacture of shoes to permit the use of the feet in as nearly as possible normal manner. The article is illustrated by numerous pen and ink drawings.—*John L. Porter, M. D., Chicago.*

An Inexpensive Mechanical Treatment for Anterior Metatarsalgia. By Ernest B. Young. *Boston Med. and Surg. Jour.*, Mar. 29, 1906.

In certain cases where pain is referred to pelvis, lower back and hips in women, relief may be obtained by proper shoes and correct methods of standing. Many cases show lowering of anterior transverse arch of foot. This can be relieved by a small pad of sole-leather, glued and later nailed inside the shoe just behind the heads of the middle metatarsal bones. This much cheaper than metal plates, and easier to fasten than the familiar wooden button. The leather and rubber tips made for the ends of chair-legs can be pared down and screwed into soles, but are not quite so satisfactory.—*Edwin W. Ryerson, Chicago.*

Treatment of Joint Disease by Passive Congestion. By H. F. Hartwell. *Boston Med. and Surg. Jour.*, May 3, 1906.

Theory of healing effect of hyperemia. Technique described. A mild degree of constriction, for a period of not over one hour, should be used in tuberculous joints. For gonorrheal joints this can be lengthened to two or three hours. Five tuberculous and five gonorrheal case-reports appended, nearly all showing definite improvement attributed to the treatment.—*E. W. Ryerson, Chicago.*

Remarks on the Infections of Joints. By R. W. Lovett. *Boston Med. and Surg. Jour.*, May 24, 1906.

Acute joint infections divided into four classes:

(A) Joint involvement secondary to acute osteomyelitis of articular end of long bones.

(B) Acute suppurative synovitis.

(C) Acute plastic synovitis leading to joint obliteration.

(D) Acute serous synovitis.

Class A needs no comment. Class B occurs in connection with nearly all of the infectious diseases, and in direct joint infections. Class C is a non-suppurative inflammation sometimes seen in gonorrhea and influenza.

Class D occurs in the general infectious diseases, and also without obvious infectious cause. It is very probable that tonsillar infections will explain many of these cases, especially those of acute articular rheumatism. They may be due to actual bacterial invasion, or to toxins. Cocci have been found in some cases, but are absent in the majority. The evidence seems to identify acute articular rheumatism as an "attenuated pyemia." The chronic rheumatoid arthritides have certain suggestive points of similarity, but nothing definite can as yet be stated as to their possible bacterial origin.—*E. W. Ryerson, Chicago.*

Classification of Cases Heretofore Called Rheumatoid Arthritis. By P. William Nathan, New York. *Am. Jour. Med. Science*, Jan., 1906, CXXXI, 1, p. 55.

This article is limited to "rheumatoid arthritis" in contradistinction to osteo-arthritis, i.e. to those joint diseases which primarily involve the synovial membrane and soft parts of the joints, in distinction from those joint diseases which primarily involve the adjacent bone. These rheumatoid cases Nathan divides into (1) metabolic joint diseases and (2) infectious polyarthritis. The metabolic joint diseases he subdivides into an arteriosclerotic form, which consists of a hardening of the soft structures of the joints beginning with the peripheral joints and proceeding toward the center, and an auto-toxic form, which is quickly deforming. The metabolic joint diseases are usually chronic from the start, while the infectious joint diseases may be acute.—*William E. Blodgett, Detroit.*

Madelung's Deformity of the Hand. By Poulsen. *Hospitalstidende*, Copenhagen, XLVII, Nos. 31–32. Abstract from *Jour. Amer. Med. Assoc.*, March 18, 1905, Vol. XLIV, No. 11.

The author gives an illustrated description of 2 cases and reviews 38 in the literature. All but 8 of the patients were women. Linear, oblique osteotomy of the radius restores conditions approximately to normal. His technique is described in detail, with radiograms.

Tardy Rachitis. By Curschmann. *Mittheilungen a. d. Grenzgebieten*, XIV, 30. Abstract from *Jour. Amer. Med. Assoc.*, April 8, 1905, No. 38.

Curschmann warns that all vague disturbances in gait at puberty should not be summarily attributed to a spinal affection without first weighing the possibility of tardy development of rachitis. He reports a case of this kind. In another case he found an apparently monosymptomatic genu valgum adolescentium as the sole but unmistakable sign of tardy rachitis. He advocates treatment of the possible underlying rachitis as a routine measure in cases of genu valgum and genu varum in persons between puberty and 20, putting them all on phosphorus and cod-liver oil, and keeping them in bed, with possibly hydrotherapy. These measures are particularly urgently indicated in incipient cases, and will always prove a useful adjuvant to surgical or orthopedic measures. His patients were a girl of 18 and two young men.—*William E. Blodgett, Detroit.*

Mobile Exostoses and Traumatic Bursa. By Toussaint. *Revue d'Orthopédie*, T. VI, No. 1, January, 1905.

Reports a case of painless tumor over the insertion of the semitendinosus and sartorius that had gradually developed after a fall five years before. Operation showed a thick bursal sac, filled with viscid fluid, and inclosing three partly ossified, unattached cartilage bodies. There was also an attached osteophyte.—*William E. Blodgett, Detroit.*

A Case of Traumatic "Exostosis Bursata," etc. By Karl Röper. *Arch. f. Orthopädie*, Bd. III, Ht. 1.

Floating bodies within a previously normal joint result either from the introduction of foreign substances or from the accidental separation of small portions of cartilage or synovia which may subsequently hypertrophy or calcify. Authorities do not all agree, however, as to their traumatic nature or that a joint containing a floating body could have previously been healthy. The author quotes the authorities of both sides of this controversy and places on record a case of a large floating body in the elbow-joint which resulted from the accidental tearing off of the tendon of the biceps muscle from the tuberosity of the radius.—*Walter G. Stern, Cleveland, O*

Separation of the Lower Epiphysis of the Radius. Condition Twenty Years Later. By Walther. *Rev. d'Orthop.*, Sept., 1905, VI, 5, p. 385.

A boy of nine years fell, and was believed to have fractured the lower end of his right radius. Twenty years later, radiographs showed that the epiphysis had been separated. The right radius was 7 cm. shorter than the left, and the shaft showed trophic changes. On the anterior surface of the radius at the carpal end, was an exostosis of considerable size. The lower end of the ulna was half way down the side of the carpus, opposite the cuboid, which was turned so that its long axis was parallel to the long axis of the arm. Three radiographs are appended.—*William E. Blodgett, Detroit.*

Muscle Transference, with the Report of Two Cases of Transference of a Branch of the Trapezius to a Paralyzed Deltoid. By E. H. Bradford, M. D., Boston. *Boston Medical and Surgical Journal*, Oct. 5, 1905.

The author discusses the status of muscle and tendon transference in paralytic cases and the various technical procedures useful in the operation such as the lengthening of tendons by strong silk. He reports two cases of transference of sections of the trapezius muscle into the deltoid, with brief description of the technique, in which excellent results followed after one and a half and three years. He also reports four other cases of various kinds, including the insertion of the sartorius into the quadriceps extensor, or the biceps into the patella, the transference of the insertion of the peroneus brevis to the anterior tibial and of one-half of the Tendo Archillis to the inner and the outer sides of the tarsus respectively in two cases.

In all of these improvement followed and in some excellent functional results were obtained. He concludes by formulating three principles:—First, the muscle which is cut must not be left relaxed, in other words, must be kept in a state of tension. Second, if a strong muscle is to be inserted into a weak one, the insertion must not only be strong but the receiving tendon must not be so disorganized by paralysis as to stretch when the transferred muscle contracts. Third, the transferred muscle must be attached in such a way and at such a point as to render its contractions functionally efficient.—*John L. Porter, Chicago.*

Infantile Paralysis.

P. Le Breton, M.D., Buffalo, N. Y. (*Journal A. M. A.*, January 6), describes the general and special methods and indications for the relief of the deformities and weaknesses resulting from anterior poliomyelitis after the subsidence of the acute stage. He lays down the general principles of treatment and applies them to the various special conditions. Each special deformity or paralysis is mentioned and the particular appliance or treatment required is pointed out, the object being to supplement the generally deficient data of the text-books and to give in concise form the latest methods and practical points of use to the practitioner. In conclusion the various operative methods, nerve and tendon transplantation, arthrodesis, and linear osteotomy are described with their special indications and modifications for different conditions. Le Breton insists on the importance of the physician foreseeing and preventing deformity as far as possible in these cases and of special individual treatment. The article is illustrated.

Technic of Tendon Suture. By Wilms and Sievers. *Zentralbl. f. Chir.*, Oct. 7, '05.

Authors have for 2 years employed the following, a modification of the oldest (simplest), method of suture. At the beginning and end of the simple suture the needle is passed under a small bundle of tendon fibers, thus forming two loops, each including a few fibers, which give increased strength to the suture when they are drawn tight in tying; the modified suture sustained a weight of 5 kilograms, the simple one a weight of but 1 pound.—*David Silver, Pittsburg.*

A Typical Affection of the Tendo Achillis. By A. Schanz. *Zentralbl. f. Chir.*, Dec. 2, '05.

A painful swelling of the Tendo Achillis, due to over-use, as in bicycling, mountain climbing, etc., is described and named "Tendinitis achillea traumatica" by S., who says he does not find it mentioned in the literature accessible to him. It differs from achillodynia in that the tendon itself and not its point of insertion is the seat of pain. The spindle-shaped thickening, which S. thinks is probably due to an inflammatory process in the tendon, caused by stretching, varies in extent and sensitiveness. The adhesive strapping used in treatment starts at the base of the toes, the foot being in slight plantar flexion, and is carried over the sole and heel up onto the calf. (The affection is described in Whitman's Orthopedic Surgery under "Strain of the Tendo Achillis".)

Same. By Drehmann. *Zentralbl. f. Chir.*, Jan. 6, '06.

D. has often seen the affection of the Tendo Achillis described by Schanz. According to him, the swelling occurs about a hand's breadth above the heel and is a tendinitis due to irritation from the edge of the shoe. Athabegian has shown that in rising on the toes with the knees bent the Tendo Achillis moves away from the tibia; this movement occurs especially in bicycling and mountain climbing, so it happens that the tendon is rubbed by the top of a shoe which in walking on the level fits well; if the edge of the upper is especially unyielding or is narrow, the rubbing is sufficient to cause a tendinitis.—*David Silver, Pittsburg.*

Dislocation of the Peroneal Tendons. By Ruotte. *Arch. provinciales de Chir.*, Mar., 1905. Reviewed in *Munch. Med. Wchnschr.*, Sept. 12, 1905.

Ruotte sums up the twenty-six cases to be found in modern literature and adds three cases of his own. This deformity is most common among the laboring classes and leads to serious impairment of a laborer's capacity for work. The treatment is immediate reduction of the dislocated tendons and fixation of the foot for at least three weeks.—*W. G. Stern, Cleveland, O.*

Recent Surgical Methods in the Treatment of Certain Forms of Paralysis. By A. H. Tubby, M. S., F. R. C. S., London. *British Medical Journal*, March 3, 1906. Hunterian Oration.

The types of cases used to illustrate the remarks made are those arising from anterior poliomyelitis, spastic paralysis, ischemic paralysis, and some traumatic lesions of the nerves. The author gives a complete history of tendon and muscle grafting, starting with the work of Nicoladoni, done in 1881, showing the development of these surgical procedures, and describing the various operations which have been in vogue. In speaking of the operations to replace the deltoid by means of muscle grafting for Erb-Duchenne paralysis, he says that the results have not been satisfactory. For the relief of Volkmann's contraction of the upper extremities, or ischemic paralysis, he states that tendon elongation, though a tedious affair, is a more scientific form of treatment than shortening the bones of the forearm, inasmuch as when one-half inch of the bones is taken away, the muscles may become useless. In estimating the results at tained by tendon and muscle transplantation, it is necessary to consider how far an apparently paralyzed muscle is capable of recovery, if aided by removing the harmful effects of constant stretching, and by reinforcing its tendon. Even when muscles give the reaction of degeneration, we have no means, so far as is known, of measuring exactly what is the extent of the degeneration. The process of regeneration sets in some time after paralysis and fatty degeneration have occurred, even as late as seven or nine months. If this observation be true, a very hopeful outlook and strong justification is afforded for the reinforcement of partially paralyzed muscles.

Looking at the question of tendon transplantation as a whole, much more successful results are obtained by insertion into the periosteum than by anastomosis. The former method gives the best results that can be obtained, as far as point of insertion is concerned; and Lange's method of lengthening tendons renders this proceeding effectual.

He points out the advantages of arthrodesis in the treatment of infantile paralysis, where the joint is hopelessly flail-like, and says that this operation, combined with the tendon transplantation, affords the best results where the amount of after-care the patient can secure is limited.

The literature on nerve anastomosis and transplantation is carefully reviewed. He states that much has been done to show that nerve anastomosis is well within the range of operative therapeutics, and suggests that great care should be taken in considering these procedures, to ascertain in any nerve the exact position of the nerve-bundles supplying certain muscles and groups of muscles.

In conclusion, he states that we feel in attacking paralytic affections, either by tendon grafting, muscle transplantation, or nerve anastomosis, that we are confronted by a most intricate problem; but the early results following operative treatment, considering the comparative failure of all the preceding measures, seem to justify a very careful and well considered trial in suitable cases.—*Nathaniel Allison, M. D., St. Louis.*

Birth Palsy of Spinal Origin. By F. Robbins. Reports in the *New York Med. Jour.*, March 10, 1906, p. 506.

A case of total paralysis of the right arm following an easy labor in which on the fourth day of putting the child flat on its back with arms above head and middle fingers touching, a pull on the feet brought both arms down at once flexed at elbow in attitude of defense on chest and then extended to drop along the body. This was repeatedly demonstrated. Dr. Dobbins calls attention to the curious fact that the position in which the greatest amount of tension is put upon the fifth and sixth cervical roots should result in a temporary restitution of conductivity in the musculo-cutaneous nerve. He infers that the roots may have been stretched only and not torn off.—*G. W. Fitz, Boston, Mass.*

Brachial Birth Palsy. By L. P. Clark, M. D., A. S. Taylor, M. D., and T. P. Prout, M. D. *American Journal of the Medical Science*, October, 1905.

The authors have collaborated in a rather exhaustive study of the entire subject of the so-called "obstetric paralysis" of the arm, and report seven cases operated upon (A. S. Taylor) with results and give in detail the technique of the operations.

The discussion of pathology (T. P. Prout) is especially interesting as microscopic and histologic studies were made of the lesions excised in the cases operated upon.

"The rupture of the perineural sheath and the resulting hemorrhage into its substance of the nerve bundle" are demonstrated and the importance of these factors in the production of the ultimate lesion and in the prevention of spontaneous recovery are dwelt upon.

In the chapter of the symptomatology and diagnosis the author (L. P. Clark) refers to this same point. He says, "When an infant remains peevish and fretful for a considerable period after this accident at birth and when handling of the extremity greatly increases the pain and irritability, there is present a traumatic neuritis aggravated by pressure incident to the organization of the blood clot and repair of the rent in the perineural sheath. Cases that do not present this symptom will show a more or less complete spontaneous recovery; while in those cases presenting these signs of a neuritis a considerable palsy will follow, depending upon the severity of the lesion."

The results of the seven operations show:

First: A mortality of 30 percent from shock, the "lymphatic diathesis" or some similar cause, as the wounds remain sterile.

Second: The return of function in the nerve requires months and the longer the time between injury and operation the slower it returns.

Third: Cases 2 and3, two years or more after operation, show marked improvement in use of the arm. In the other three cases sufficient time has not elapsed to warrant conclusions as to extent of functional use of the arm.

The conclusions drawn by the authors are in brief: First, that the cause of this type of birth palsy is tension on the nerve trunks which first ruptures the nerve sheath and then the fibers, and the prevention of the accident lies with the obstetrician in a more careful technique in the delivery. Second, in all cases treatment to prevent contractures and deformity and to maintain muscle tone should be used until spontaneous recovery occurs or operation is done. Third, the proper time for operation is not definitely fixed but about one year seems to be long enough to wait for spontaneous recovery.

The article is fully illustrated and a voluminous bibliography is appended. —*John L. Porter, M. D., Chicago, Ill.*

Spontaneous Amputations. By Hovorka, Vienna. *Zeit. für Orth. Chir.*, Band XV, Heft 1.

Report of a case involving left forearm. Two great divisions of spontaneous fracture, first, the congenital, second, the acquired. Discussion of the congenital. Three classes. First, amputation of the upper leg or arm, second, amputation of the lower leg or arm, third, that involving fingers and toes.

The condition is a secondary development following pure mechanical disturbances of growth. The best evidence of this is the Röntgen findings which show normal anatomical conditions of the bones in the stump.—*Henry O. Feiss, Cleveland, O.*

A Case of Congenital Malformation of the Four Extremities. By Max Blumenthal and Karl Hirsch. *Zeit. für Orth. Chir.*, Bd. XIV, Ht. 1.

Female, aged 45. Two other malformations in the same family. Birth normal. Present state: Intelligent person, 111 cm. long. Description of extremities: Left upper extremity presents only an upper arm and a finger. The Röntgen picture shows the finger consisting of three phalanges and articulating to the humerus with two little bones between the metacarpal bone and the humerus. The right upper extremity presents only the humerus which ends below as a tapering stump. The left lower extremity lacks femur and fibula. The right lower extremity presents a bony stump in which there is to be seen a small protrusion resembling a foot with a heel, sole and two toes. Writers call the upper extremities "end defects." Both lower extremities answer to the description of "phocomelia." This patient, in spite of her defects, can write, knit, partially dress herself, wash herself, and eat with knife and fork. She uses an artificial right leg.—*Henry O. Feiss, Cleveland, O.*

Congenital Defect of the Thorax. By Silberstein. *Zeit. für Orth. Chir.*, Band XV, Heft 1.

Review of literature. Case 1. Thorax. Left half of chest drawn in. Absence of the anterior arches of the third and fourth ribs. Left hand shriveled. Fingers present deformities.

Case 2. Caput obstipum and shortening of sterno-mastoid on left. Right shoulder high. Gutter-shaped shallowing of the left anterior chest. Ribs on this side deficient in front. Six of them have prominent button-shaped ends. Discussion of the pathogenesis. Many cases must be regarded as an arrest in development of embryo. Other cases are intrauterine disturbances of development of mechanical origin of which the most important factor is diminution of space in the uterus resulting from deficiency of amniotic fluid.—*Henry O. Feiss, Cleveland, O.*

Anomalies of Position and Attitude in Rachitic Children. By Brandenberg, Winterthur. *Zeit. für Orth. Chir.*, Band XV, Heft 1.

Author calls the attention of orthopedists to the work of E. Hagenbach-Burckhardt (*Jahrbuch f. Kinderheilkunde N. F.*, LX, Heft 3) which lays stress on the part taken by the muscles in rachitic deformities. Emphasis is laid on such deformities as rachitic flat-foot in which static conditions could not have had effect as the deformity may appear before the period of weight-bearing. In rachitic kyphosis author also lays emphasis on the muscular weakness.—*Henry O. Feiss, Cleveland, O.*

Plaster Treatment in Sciatica. By H. Kramer, Koln. *Zeit. für Orth. Chir.*, Band XIV, Heft 3-4.

Writer applies plaster to the leg and foot, followed later by massage and mechanical exercises. In 8 cases out of 9 he had excellent results. The pain disappeared right after the application and improvement followed very rapidly. The importance of the immobilization is two-fold, first, the diseased nerve is relieved of pressure and traction, and second, the venous hyperemia is favorably influenced, for on account of the lasting horizontal position of the leg the congestion of the veins disappears.—*Henry O. Feiss, Cleveland, O.*

A New Pelvic Support. By Julius Finckh. *Zentralbl. f. Chir.*, Sept. 30, '05.

F. calls attention to the fact that when the patient lies on the usual pelvic support, the buttocks, being unsupported, hang down like two sacks, whereas in lying on a more or less hard surface, they are flattened; in the application of a cast with the ordinary support the buttocks, therefore, not being sufficiently compressed, sink more or less when the patient is removed, thus permitting a change in the position of the pelvis. The support which he has devised has two adjustable and removable plates upon which the buttocks rest while the sacrum is left unsupported; a comfortable and stable rest with compression of the buttocks is thus secured. Two illustrations of the support are added.—*David Silver, Pittsburg.*

A New Pelvic Support. By H. Legal, Breslau. *Zeit. für Orth. Chir.*, Band XIV, Heft 3-4.

Consists of a padded stool placed upon a table, across which a stout strap is stretched parallel to the long axis of the table. The one end of this strap is fastened to a vertical upright at the end of the table. The patient is placed with the upper part of his back on the stool and his pelvis upon the padded strap, which can be tightened to any extent. Then the plaster is applied while an assistant holds the legs.

The advantages are that lying on the strap the pressure upon the pelvis is not painful and that the support so offered fits to the natural contour of the body.—*Henry O. Feiss, Cleveland, O.*

Mikulicz's Operation for Torticollis. By L. Rousseau, Paris. *Rev. d'Ortho.*, Jan., 1906.

Dr. Rousseau favors operation in advanced cases rather than to try brace or other orthopedic treatment in torticollis. He reviews all the cases collected from the German, Belgian and French literature, one hundred and two in all. He cites and discusses the objections to the operation and believes that in inveterate cases it is the operation of choice. Orthopedic treatment is useful in these cases after operation not only for the condition of the neck but also for the curvature of the spine.

After a more or less extended time the mobility of the head and neck becomes normal, the scoliosis may be improved but the facial asymmetry is not apt to improve.—*Robert Soutter, Boston.*

Congenital Torticollis with Cranial Deformity, in a New-born Boy. By Tridon. *Rev. d'Orthopédie*, Mar., 1906, VII, 2, p. 171.

Child delivered by forceps. At birth had a left sterno-mastoid torticollis. Left sterno-mastoid hard and tender. Left eye on higher level than right, instead of lower as usual in left torticollis. This is probably to be explained by the cranial deformity, due to pressure at birth.—*William E. Blodgett, Detroit.*

Muscular Wry-neck. By O. Foederl. *Arbeiten aus dem Gebiete der klin. Chir.*, 1903. Abstract *Zentralbl. f. Chir.*

To fulfill both functional and cosmetic demands in the operation for wry-neck, F., in Gussenbauer's clinic, used the following: Vertical incision, 3 to 4 cm. suffices, between heads of sterno-cleido-mastoid; clavicular portion is divided at its insertion and freed up to sternal portion from which it is then separated as high up as possible; at this point sternal portion is divided; after excision of contracted portions of platysma, cervical fascia, and cucullaris, deformity is corrected until head reaches upright position; cut ends of muscle are then sutured with catgut, an amount of lengthening corresponding to the ength of clavicular portion being thus obtained. The operation is simple and the loss of clavicular portion does not impair the functional or cosmetic result. The head is held in the upright position by a dressing, in which, by means of elastic traction working in the direction of the opposite muscle, overcorrection is begun in the second week. Treatment generally ends with a satisfactory result in the third week, the average stay in the hospital being 18 days. Fourteen cases operated upon by this method between 1897 and 1900 are reported in detail; those of the next 2 years are not given as they were too recent to report end results. In one case overcorrection according to Lorenz was carried out and the patient suffered from collapse; in 2 of the remainder, in which correction was carried out only to the upright position, emphysema of the head and chest developed. The etiology is considered.—*David Silver, Pittsburg.*

Congenital Defect of the Femur. By Dr. F. Lartaria, Naples. *Revue d'Orthopédie*, 1904, Vol. VI, p. 481.

The case was that of a girl of 10 years. At the age of three years she had had a severe fever with convulsive contractions of the left leg. The leg became swollen, but there was no suppuration. Following this the leg did not grow. At the age of ten years there is shortening and atrophy of the thigh and calf and of the foot. Dr. Kirmisson was asked his opinion and considered the case one of congenital atrophy of the femur. There is a detailed report of this case and of two others found in literature. (Kirmisson, Maladies Chirurgical, 1898, p. 649; and Fochier, *Revuede Chir.*, F. XXIII, 1901, p. 138.) —*Robert Soutter, Boston.*

The Diagnostic Value of Tuberculin in Orthopedic Surgery. By W. S. Baer and H. W. Kennard. *Johns Hopkins Bulletin*, Vol. XVI, No. 166, January, 1905.

Authors' conclusions:

1. Tuberculin is the best and most reliable diagnostic agent for incipient tuberculosis of bones and joints.
2. Its proper administration is attended by no permanent harmful effects.
3. The dosage is variable and it is rarely necessary to exceed a dose of 6 milligrams.
4. The local signs are of equal, if not greater importance than the general reaction, in bone and joint tuberculosis.
5. Tuberculosis practically always reacts to tuberculin.
6. Diseases other than tuberculosis may possibly react to tuberculin, but the evidence on this point is not conclusive.
7. The diagnosis of tuberculosis can be made earlier and with more certainty by means of tuberculin than by radiography.
8. The tuberculin test is applicable to private and dispensary as well as to hospital practice.

A bibliography is appended.—*William E. Blodgett, Detroit.*

Technic of Bier's Method of Passive Hyperemia. By Mindes. *Zent. f. Chir.*, Jan. 20, '06.

M. describes a simple instrument for producing easily any desired degree of hyperemia. It consists essentially of a roller, provided with ratchet and key, and two rods, forming the base; a woven rubber band is fastened to one rod and carried around the limb under the other rod to the roller; tension is easily controlled by means of the ratchet.—*David Silver, Pittsburg.*

"Traction, as Applied to Tubercular Joint Conditions." By Prescott Le Breton, M. D. *Buffalo Med. Journal*, Dec., 1905.

Le Breton confines his discussion to ordinary cases of tubercular trouble. Since the indications for traction in all joints, with the exception of the hip, are well defined and accepted by all authorities, he passes over them very briefly.

He quotes Lorenz, Whitman, Dane, Lovett and Packard, as to their views of traction in hip-joint disease, showing that the treatment is not in a settled condition. The writer uses a combination plan of treatment with good results. Fixation in a good position, and traction while spasm and sensitiveness are present, are essential. Then a plaster spica is applied and patient gets about with aid of crutches and a high shoe. Later he uses a leather spica and jacket, strengthened at the groin with extra leather and a piece of steel. The ultimate aim is to secure ankylosis in a good position.—*Chas. R. McClure.—Cincinnati, O.*

The Employment of Water Power in Surgery and Orthopedics. (A New System of Orthopedic and Medico-mechanical Apparatus.) By Machol. *Zentralbl. f. Chir.*, Feb. 10, '06.

Author has devised a system of apparatus for the correction of deformity in which the power is furnished by flowing water; in apparatus for correction only ("passive"), the force pump is used; in medico-mechanical apparatus ("active"), both force and suction pumps. The advantages claimed are:—1, simplicity; 2, equal and constant pressure, which may be exactly regulated; 3, constant effect, the force continuing to act even after partial correction has been obtained. Illustrations of the (passive) apparatus used in the correction of scoliosis and of the medico-mechanical (active) apparatus for the elbow are given.—*David Silver, Pittsburg.*

Disturbance in Growth Following Short Exposures to the Röntgen Rays. By Foesterling. *Zentralbl. f. Chir.*, May 12, 1906.

To all those employing the X-rays, F.'s investigations into their effect in causing disturbance in growth are of value. In his first subject, an 8-day old dog from a litter of 5, the left hind leg was exposed a single time for 10–12 minutes (focal distance 20 cm.). After about 14 days the hair over the entire dog dropped out; dermatitis did not develop; in 4 weeks the hair began to grow again but the development of the entire extremity was retarded, although the covering of hair became more nearly normal; when the animal was killed at 7½ months, its entire development was somewhat less than that of the others. Further experiments gave similar results, growth in the exposed parts being retarded. In all 2 animals were exposed, with resulting disturbances in growth when the exposure was long enough; usually 10 min. was sufficient and none were exposed over 20 min.

Branches of maple, chestnut, rhododendron, and other plants, on which the buds were about to open, were also exposed for 20 min. In 2 to 3 days the buds on the exposed branches were in each case less far advanced than those on the unexposed, and after 8 days the exposed buds and leaves withered while the unexposed remained green and opened wider.

Author reaches the conclusion that in growing animals a single short exposure to the X-ray, one less than the usual therapeutic dose, may, and almost always does, produce considerable retardation in growth of the part exposed. The least amount which can produce injury is not yet known.—*David Silver, Pittsburg.*

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The American Journal *of*
Orthopedic Surgery

I.

PRESIDENT'S ADDRESS.

Our Association has entered upon the twentieth year of its history. Its name—a happily chosen one—is broad enough to include all surgeons of this western continent who show their love for and their devotion to that department of surgery which claims our loyalty and demands that we do what we can, on the one hand, to demonstrate to the profession its far reaching and beneficent purposes and, on the other, that we reach and alleviate the ills of humanity which come to our notice because we have chosen this particular field of labor.

We meet today under another—I am confident in saying not to any member of this Association really an *alien*—flag. If the Association had its birth and if it has received its nurture under the Stars and Stripes, yet its aims, its lines of influence and, in some measure, its sources of inspiration and strength are broader and more far reaching than any nominal, national boundary line. There is a citizenship of science and service, of humanitarianism and Christianity which has the world for its field, which seeks out all who need help and counsel irrespective of nation, color or creed. It is my very pleasant duty today, as your president—greatly honored by the trust and confidence thus reposed in me—to express warmest words of welcome to those who are present at this first meeting under the friendly, motherly folds of the Union Jack. As citizens of Anglo-Saxondom it is quite appropriate that we avail ourselves of this auspicious meeting and recall not only the many proofs of united action for the common weal of our own fellow-citizens, but also for the wellbeing of men of every clime and nation.

The Union Jack and Stars and Stripes entwined in friendly embrace are the world's most promising influence today making for peace and good fellowship.

"* * * fling them out to the breeze,
Shamrock, Thistle and Rose,
And the Star-spangled banner unfurl with these,
A message to friends and foes,
Wherever the sails of peace are seen,
And wherever the war-wind blows.

"A message to bond and thrall to wake,
For wherever we come, we twain,
The throne of the tyrant shall rock and quake,
And his menace be void and vain;
For you are the lords of a strong, young land,
And we are the lords of the main.

"Yes, this is the voice on the bluff sea gale,
We severed have been too long;
But now we have done with a worn-out tale,
The tale of an ancient wrong.
Let our friendship last long as love doth last,
And be stronger than death is strong."

It may not be inappropriate to refer to the great meeting of medical practitioners from nearly all parts of the world, which is being held in this city this week, to show still further how far harmony of purpose and unity of action have extended between those who speak our mother-tongue. Though nominally the *British* Medical Association, yet as many citizens of the United States as from Britain find a place on the program.

The work of our own Association has gone on so smoothly during the year, the committees and methods of procedure already established have been so adequate, that, as in times of a nation's peace there seems to be but little to chronicle. The year abroad, also, so far as our work is concerned, has not been marked by any great, outstanding facts which demand consideration at this time. Perhaps the most significant and far reaching advance in recent years, relating to the work of our profession, is that grappling with the great white plague. While in this humanitarian effort the medical profession, as is seemly, leads the van, yet it is worthy of note that in no other effort of a similar kind in history has the laity taken so large a part. The chief elements in the progress made consist in the discovery that it is a germ disease, that no tissue is safe from its ravages, and in the greater appreciation of Nature's benign power to sustain health and vigor. Sunshine and fresh air command a premium never known before.

The Journal has continued to appear at regular intervals, ably edited and freighted with many articles of great value, of which, doubtless, a full report will be given, embracing recommendations from our very efficient publication committee. The published articles of our transactions are being referred to more and more abroad. A review of the subjects presented in our meetings from year to year goes to show that we are bringing forward more articles that are based not upon the empirical only, but that our younger members especially are doing more work which has its foundation in carefully thought-out observations of scientific facts.

The natural qualifications which the orthopedic surgeon should possess and the training which he receives lay upon him special responsibility to advance the mechanical aspects of surgery, and the ardent and intelligent cultivation of this field is gradually broadening the work of the orthopedic surgeon so that he is reaching out and effecting a more complete cultivation of fields that were hitherto neglected. If one recalls the comparatively large number of persons who have sustained fractures, the recovery from which has been marked by great disability resulting from mal-adjustment or imperfect retention, he will recognize the need of a better knowledge of the mechanical principles involved and of more efficient treatment. Upon whom should the responsibility fall so properly as upon us, whose thought and energy are devoted constantly to the study of the mechanical principles involved in the architecture of the human body? There can be no reasonable doubt that there is much room here for raising the practice of surgery to a higher plane of efficiency. Under present conditions of practice probably we are seldom called to see ordinary fractures and yet there is no group of men in the profession whose daily work qualifies them to bear this responsibility so creditably. Would not the discussion of this subject do something to contribute our share to the general advancement of the science?

There is another class of patients referred very commonly to the neurologist, whose disabilities can be ameliorated much more appropriately by one whose training qualifies him for recognizing and meeting the resulting mechanical deficiencies. In very many, or most, of the paralytic affections, especially as seen in children, medical treatment is of little avail, and after the acute symptoms have passed away many and serious are the resulting affections, not only from the paralysis directly but from the deformity. His knowledge of the deformities which must soon follow, if not prevented by scientific means, lays upon the orthopedic surgeon more than upon any other, the duty of assuming responsibility here. If the patient be not brought to him for advice till disabling deformity has ensued, then it is he who is best qualified to afford relief both by operation and mechanical means. Along these lines there is a definite responsibility resting upon us and a manifest duty to contribute our share to the general advancement.

There is still another class of patients who may well look to us for help and guidance. Together with the neurologist we ought to share the responsibility in dealing with the troublesome class of affections which rest upon a neurotic foundation. They come to us frequently for advice and a vexed problem is presented to us for solution; namely, to determine how far the disabilities manifested are due to actual, organic, mechanical inefficiency and how far due to functional derangement. The special use of physical training for remedial purposes has been largely assigned to or assumed by us and its field of possibilities has been so much widened and elucidated that we have now at hand a powerful means to aid us in the direction, the testing and treatment of this numerous and difficult class of patients. No problem can be presented to the mind of the careful, studious physician more difficult to solve than to determine in the disabled neurotic just what elements are the result of organic disease and what are due to the patient's erratic fancies and misdirected energies. Not a few of these cases, doubtless, are approaching the borderland which separates between sanity and insanity. In his practical dealing with these cases, seeing that they seek so largely the advice of the orthopedic surgeon, he can often render most valuable aid, not only to the patient but to the profession also.

It becomes my sad duty to make brief reference to the losses sustained during the year in the death of three highly esteemed, lovable and painstaking members of the Association, each of whom had, during his years of service, made for himself in the literature and work of the profession a name which shall stand high and secure as a helper of humanity.

Dr. Louis A. Weigel, of Rochester, was one of the best known surgeons in the State of New York. He died a martyr to his devotion to his chosen profession, May 31st, at the early age of fifty-two years. He was born in Rochester of German parentage. His father was a physician. He lived and labored in Rochester all his life except for the years spent at college. He was graduated from Maryland University in 1875 and in 1877 married Miss Elinor Regester, of Baltimore. For a number of years he was in the general practice of medicine, but about twenty years ago began to devote his attention to the work of orthopedic surgery. His peculiar qualifications and his well-directed enthusiasm in this work speedily carried him into the front rank. Of an artistic nature he was always much interested in photography, in which he became much more than an amateur. The same bent led him to devote himself most unreservedly and unselfishly to the Rœntgen ray work. He was not unacquainted with the possible risks involved, but continued with such assiduity to devote himself to his work that in a manner with which we all have become acquainted, he laid down his life in the pursuance of his work. I am glad to say that we are to hear more fully concerning the nature of the illness which caused his demise from one of our members, Dr. Roswell Park, who is so well qualified to deal with this important subject. Dr. Weigel had occupied the president's chair of our Association and by his unremitting urbanity and readiness to serve his fellows he had won the universal goodwill and confidence of the membership. His wife, who survives him, has the deepest and most cordial sympathy of our Association.

Dr. John Combe Pegram, Jr., was born in Bristol, Rhode Island, on July 25th, 1870, being the only son of John Combe and Isabel Homer Pegram. He studied as St. Mark's School, Southboro, Mass., entered Brown University at Providence and was graduated as Bachelor of Arts in 1892. He was graduated from the Harvard Medical School in 1897 and for a number of years received many important appointments and occupied responsible positions in connection with the various public institutions where he resided.

It is unnecessary that I should speak of the retiring manner, the self-forgetful behavior and the assiduous devotion to the work of the Association which has marked Dr. Pegram's membership; nor, need I refer to the valuable articles which he has already contributed. In the death of Dr. Pegram the Association has lost one of its younger and promising members and his widow, Mrs. Elizabeth Harriott Pegram, may feel assured of the very warm sympathy which the members of the Association extend to her in her bereavement.

Dr. Hosmer, of Chicago, was fifty-two years old when he died of pneumonia. He was graduated from the Chicago Medical College in 1875 and did post-graduate work in the New York hospitals. Beginning practice in Chicago he continued in general practice for some time and afterward entered into partnership with Dr. Stillman. After Dr. Stillman's death he continued his interest in orthopedic surgery and later was appointed upon the orthopedic service as St. Luke's Hospital, in the work of which institution he continued to take an active interest until the time of his death. For varying periods of time he was also associated with the work done in the Home for Destitute Crippled Children and with the teaching in the Chicago polyclinic. In 1893 he was elected to membership in the American Orthopedic Association. During his service at the polyclinic Dr. Hosmer did a large amount of original work, including experimental investigation of the process of repair in sprains and contusions of the joints, which he reported to this Association in 1902. At different times he devised various modifications of apparatus designed for correcting deformities of the feet and for adding to the efficiency of the Thomas hip splint. Dr. Hosmer leaves a widow but no children. His wife has the deepest sympathy of the members of the Association in the loss which she has sustained. A friend of Dr. Hosmer's has written me saying: "He was a born gentleman of a sweet and generous nature. His patients were devoted to him. . . . When he reached the side of his patient he gave close attention to every little detail and would never leave until everything was done that patience, skill and loving kindness could accomplish." Not only in this Association does Dr. Hosmer leave many who have warm and pleasant recollections of the man, but his patients will long remember his thoughtful, kind consideration given to their many ills.

The relationship between your president and the committees and the members of the Association during the year has been one of the most pleasant kind. The advice and counsel sought has been so freely and graciously given and the call for papers to furnish our program has met with such generous response, that his position has been one of honor without the corresponding cares and responsibilities of office.

II.

INTERMITTENT LIMPING.

(MYASTHENIA ANGIO SCLEROTICA.)

A Report of Three Cases.

BY ROBERT W. LOVETT, M.D., BOSTON.

A condition rare in this community but of more frequent occurrence in Russia, Poland and the Baltic provinces has been described very frequently by neurologists and physicians under the name of intermittent limping. This name is misleading because it does not lay stress on the essential feature of the disease, which is a disturbance of circulation frequently severe enough to lead to gangrene. Other names which have been applied to the condition are as follows: intermittent claudication; claudication intermittent (Charcot); intermittirendes hinken; myasthenia paroxysmalis angio sclerotica (Higier); angina cruris (Walton and Paul); intermittirende muskelparese (Grassman); dysbasia angio sclerotica; angiomyapathy; paralysie douleureuse ischemique (Charcot).

I have not been able to find that this condition has been studied by orthopedic surgeons and I therefore venture to call your attention to the practical surgical aspect of three personal cases occurring in private practice, in one of which I had exceptional opportunities to follow the disease from its beginning to its termination in gangrene in one leg and apparent arrest of the process in the other.

As early as 1839 a similar disease was identified and described in horses by Bouley and later by Rademacher, Böther, Vöfsch, Sommer and Gobaux. It was described as due to an obliteration of the abdominal aorta in bilateral cases and of the iliac artery in unilateral ones.

The symptoms were similar to those in the human subject and consisted in a lameness that came on after the animal had traveled a short distance, but disappeared after a short rest to return again soon after activity was resumed.

Charcot described the affection in human beings in 1858, and Erb has contributed much to our knowledge of it. Of late years many studies of the condition have been made chiefly by German and French writers.

The disease consists of a disturbance of the arterial circulation, most often of the lower extremities, and in some cases results in gangrene. It therefore becomes allied to the cases of spontaneous gangrene, many of which are undoubtedly due to it.

It apparently does not represent a pathological entity but is rather a condition produced by various causes and the name covers only a group of symptoms, in which respect it might fairly be compared to the term jaundice, which represents a clinical condition but represents no one pathological entity.

Symptoms.—The patient finds that in walking, after a few minutes, he is seized with a pain in the calf of the leg which makes him limp and soon compels him to stop. After a short rest he is able to proceed only to be stopped again in a short time by a recurrence of the pain. The pain at first only appears under these conditions and is absent in sitting and lying. This symptom is essentially intermittent and the disease in its first part characterized by remissions. The characteristic and essential feature is a disturbance of circulation manifested by a retardation of the arterial circulation in the affected member and absence or great diminution of the pulse in the dorsalis pedis or posterior tibial artery or in both.

That their absence of pulsation is not a frequent normal occurrence is shown by the figures of Erb who found in 700 hospital patients 1 percent without pulsation in the dorsalis pedis or posterior tibial arteries but in these there were no symptoms. Goldflam found it absent in 9 out of 200 miscellaneous cases examined. Walton and Paul examined the condition of the arteries in 200 persons from infancy to old age of whom the majority were in good health, pulsation was present in all four arteries in 181 cases. In 24 cases of intermittent limping observed by Goldflam the pulse in the dorsalis pedis was absent in 23 and in 15 the posterior tibial was pulseless on one or both sides and this is representative of the findings of other observers.

Sensations of coldness are common and the foot feels cool to the hand, the arterial blood runs in slowly and painfully in the middle stages of the disease, the toes are whitish and the foot lighter in color, yet obstruction to the venous circulation is prominent in some cases and blueness of the foot occurs when it is allowed to hang down. Sensation is described as being normal but one of my cases had a distinct area of deficient sensation on the great toe and foot near it and this area corresponded not to the distribution of nervous terminations but to arterial distribution. Prickling, numbness and similar disturbances of sensation are common. In general, mobility, coordination, reflexes and sensation are not seriously if at all disturbed.

In my cases the characteristic and striking symptoms were:

1. Pain and cramp in the calf of the leg in walking.
2. Obstruction to the arterial circulation shown by pallor and coldness of the foot.
3. Absence of pulse in the dorsalis pedis and posterior tibial arteries, in two cases.
4. Pain on letting the foot hang down when the blood entered the arteries.
5. A feeling of coldness of the foot during the night.
6. Severe spontaneous pain during the night.
7. A tender induration in the calf of the leg.
8. The existence of a static trouble in the foot in each of the cases.

The tender induration in the calf of the leg has largely if not wholly escaped attention and in the cases described, except for Idelson, the association of flat-foot has not been noted.

Etiology.—Men are much more often affected than women (120 to 7, Erb) and it is an affair of adult life, in many cases young adults being affected. The legs are commonly attacked and the disease may be bilateral or unilateral, in which case the left foot is involved oftener than the right; a few cases of involvement of the arms in what appears to be an analogous process have been reported (Nothnagel, Massaut, Schrötter, Elzholz, Bieganski, Will, Hadden, Heidenreich).

The susceptibility of Jews to the affection has been long recognized and is only imperfectly explained by their alleged susceptibility (Idelson) to early arterio-sclerosis, to psycho-neuroses, and to gout and diabetes. The large groups of cases come almost wholly from the territory mentioned above and in 65 cases reported by Goldflam, Higier, and Idelson, 62 occurred in Jews.

As to the etiology of the affection there is much discussion and many divergent views, as must be the case in unusual and recently described conditions. That an obstructive arterial disease lies at the root of most cases is admitted, but the age of most patients does not coincide with that of the greatest frequency of arterio-sclerosis and it is self-evident that arterio-sclerosis is but rarely accompanied by intermittent limping. The following causes have been advocated in this connection.

1. Mechanical obstruction has been present, as an aneurism (Charcot, Bourgeois), a truss for inguinal hernia in two cases (Van Oordt).

2. The overuse of tobacco has been given a prominent place in the etiology by Erb who found 55 percent of excessive smokers in 45 cases; other writers do not agree in this.

3. Extremes of cold and heat have apparently been associated in the cause of some cases and the disease is essentially one of a cold climate.

4. A neuropathic diathesis has been insisted on as an important factor in the etiology by some writers (Oppenheim) and given an unimportant place by others (Hagelstam).

5. Syphilis, alcoholism, and diabetes are recognized as the cause of some cases.

6. Flat-foot as an etiological factor was noted by Idelson who reported it as present in 10 out of 14 cases reported by him.

It is a familiar fact that disturbances of the circulation are a constant accompaniment of flat-foot; congestion, blueness and distended veins are almost constantly seen in the affected foot, and a sensation of burning and local sweating are early symptoms.

The anatomical conditions are such that the circulation is likely to be disturbed by a rolling over of the foot and a disturbance of its balance. The dorsalis pedis artery sends a communicating branch to the plantar arch and this branch passes between the first and second metatarsals. Moreover there are communicating branches between the dorsal and plantar arteries of the foot, one of which perforates each interosseous space. A side thrust of the foot which compresses the metatarsus is, by squeezing the bones together, likely to interfere with the circulation of the entire foot. And, secondly, Idelson calls attention in this connection to the fact that the pressure on the plantar nerves induced by flat-foot may induce a reflex irritation of the blood vessels likely to lead to disease of them. It is easy to see that slight and moderate degrees of flat-foot would be likely to be overlooked in the examination of cases made by neurologists and physicians so that the fact that it has not until recently been given a place in the etiology is easily understood. A static trouble of the foot was present in all of my cases.

7. A congenital or acquired feebleness of circulation is spoken of as an etiological factor.

Certain experiments and clinical facts bear on the etiological question. If has been shown that exposure to cold predisposes to arterio-sclerosis (Zoege v Manteuffel). Interruption of the blood supply to the lower extremities causes a condition of the muscles akin to rigor mortis, which passes away on the resumption of the circulation (Stinson and Schiffer). Angina pectoris occurs in obstruction of the arteries supplying the heart muscle. In 124 cases of severe arterio-sclerosis intermittent limping was present in only one case (Edgren).

Pathology.—The disease is in most cases accompanied by arterial obstruction, but that this may be absent is shown in a case of Pitres and Villard, where gangrene of both feet occurred in which the vascular system was intact but degeneration of the peripheral nerves was present. In most cases, however, one finds obliterating arteritis present (spoken of as the arteritis obliterans of Friedlander or Winiwarter and later called by Bilroth endarteritis hyperplastica). In addition to the vascular lesion an abnormal condition of the nerves has been frequently found. Neuritis, nerve degeneration and sclerosis have been described and an obliteration of the vasa nervorum leading to degeneration of the peripheral ends of the nerves but not of the nerve trunks (Dutil and Lamy).

In some cases the nerves and vessels are fused together in a resistant fibrous tissue, the nerve trunks œdematous and the fibrous tissue of the nerves increased while the fibres themelves are comparatively normal (Lapinsky). Muscular degeneration has been described (Marinesco and Schlesinger).

The general consensus of opinion points to an obstruction of the lumen of the vessels due to arterial disease as the cause of most cases, the nerve involvement being apparently secondary. That toxic conditions and a neuropathic tendency are unfavorable factors is generally believed, but after a careful consideration of all the data it is quite evident that very little is really known of the essential cause or character of the disease.

That the diagnosis of the disease is on the whole easy seems to be generally assumed by those authors who have reported large groups of cases. But to one unfamiliar with the unusual conditions described as Raynaud's disease and erythromelalgia it would seem that they offer many points in common with intermittent limping. Higier asserts that many of the reported cases of the two first named conditions really belong in intermittent limping. Obliterating endarteritis or arterio-sclerosis in erythromelalgia has been reported by Mitchell and Spiller, Dehio, Auerbach, Thoma, Sachs and Wiener which comprise the majority of all cases examined microscopically. In Raynaud's disease 12 percent of all cases are reported as showing vascular change. The same causes are given in the etiology of all three, all three are intermittent, trophic disturbances of the extremities occur in all three and two of them frequently terminate in gangrene. From a study of the literature one would conclude that the three conditions are closely allied and that their relation to each other could only be formulated by closer study.

The discussion of prognosis and treatment will be considered in connection with the cases to be described.

The first case to be reported is of interest because the disease was carefully observed from the first, and many therapeutic measures tried; the patient had the benefit of the advice of several eminent consultants. The disease went on to gangrene in the left leg and a pathological examination was made possible. In the right leg the disease was arrested by a certain line of treatment.

The names of the various gentlemen who were asked by me to see these patients are not given in order to prevent the identification of the patients.

CASE I.—Mr. X., a healthy young man of 25 of English birth, was referred to me by an out-of-town practitioner for flat-foot, on Nov. 23, 1904. He came of a healthy family and had always been well and active; the family and personal history were perfectly negative and the question of syphilis was later gone over again and again but he had never had any venereal diseases. He was temperate, smoked moderately and held a position of responsibility in a mill which necessitated his being on his feet and walking about from room to room during the day. For six months prior to seeing me he had had trouble in his feet and was lame at night.

Flat-foot had been diagnosticated and he bought some flat-foot plates at a shoe store which gave him relief until a few weeks before he consulted me, when the pain returned, especially in the left foot, and he had pain in the left calf in walking.

He presented routine symptoms of flat-foot, pain in the arch, some discomfort in the calf of the leg, and a little swelling and stiffness of the left foot. Both feet were pronated and somewhat flattened and he was wearing badly fitting plates purchased at a shoe store. I took casts of the feet and regarded his discomfort as largely due to improper support from his ready made plates. When his new plates were applied he spoke of feeling much more comfortable and said that he could now walk with comfort and I regarded the case as a routine one of flat-foot. Three days later he saw me as the left plate was a little high, and it was lowered.

Dec. 10. Two and one-half weeks after his first visit I saw him again because he had a good deal of pain in the left calf and I shortened and lowered the plate and he returned home. He wrote to me two or three times, giving a report of progress which was sometimes good and at other times unsatisfactory. Just before Christmas he ran into the handle of a baggage truck which struck him in the left groin. The day after Christmas the left leg became much more painful and when he visited me on Jan. 10, 1905, 7 weeks after the original visit it was evident that a great disturbance of circulation existed. If the foot was elevated and put down it was at first very white, then a pink flush slowly succeeded and then a violet or bluish tinge spread over the foot. At this time his symptoms were pain in the foot and calf on walking, subjective coldness of the foot, most marked in the early morning, and pain at first on letting the leg down, and some during the night.

Pulsation was absent in the dorsalis pedis and tibialis posticus arteries, feeble in the left popliteal space, and less strong than normal in the left femoral artery in the groin. At the wrists the arteries were resistant and apparently hardened; the general health was excellent. Thickening and tenderness were present along the inner side of the gastrocnemius at the middle of the calf. He was at once sent to a neurologist for consultation, who gave a bad prognosis and advised measures to stimulate the circulation and advised the use of iodide of potash. He remained in town and was restricted in his activity. Massage was given daily and the leg was flushed by being bandaged and constricted alternately; vibratory massage proved irritating; he was given iodide of potash, 15 grains 3 times daily. He improved under this treatment, the circulation became nearly normal and the symptoms grew less. After 11 days in Boston he returned home for a few days' rest.

A few days later he returned with a recurrence of all symptoms; at this time the leg became so painful when elevated that he used to sit up all night and soon required the use of morphine to get any rest even in this position. He was then given mercurial inunctions with no benefit. An X-ray showed nothing abnormal and the urine was normal.

He continued to grow worse so rapidly that he was moved to a private hospital where various remedies were tried; the foot became more bluish and swollen and what promised to be a line of demarcation formed about the middle of the calf. Purplish spots appeared on the toes and it was evident that amputation would soon be required. His suffering was extreme and he was unable to have the leg emptied of blood on account of the pain and let it hang over the edge of the bed resting on pillows day and night. After several consultations his leg was amputated on Feb. 22, 1905, by Dr. J. Collins Warren, at the lower third of the thigh; the wisdom of this decision was shown by the pathological report. The wound healed well and he made an uneventful convalescence. The pathologist's report was as follows:

HARVARD MEDICAL SCHOOL.

Boston, March 6, 1905.

The specimen from Mr. X., February 22d (T. 52–26), consisted of the left leg which had been amputated about 3 inches above the condyles of the femur. The lower leg and foot were extensively swollen and œdematous, the skin somewhat discolored, and there were several excoriated and slightly ulcerated patches irregularly scattered over it.

On section the femoral artery was found plugged by a soft, recent thrombus at the point of amputation. Following this down it was found to grow denser and the vessels were obliterated entirely by an older process just above the ankle and about the malleolus. There was also a thrombus of the vein about 2 inches below the knee. The muscles were everywhere sodden and in many places infiltrated with blood.

Microscopic examination showed everywhere an irregular thickening of the inner wall of the artery, varying in amount, in some places, to almost total occlusion of the vessel. To this a thrombus was adherent which in the region of the foot had become organized and showed slight traces of canalization.

Diagnosis.—Diffuse obliterating endarteritis.

W. F. Whitney.

It may be of interest to review the various therapeutic measures that were used without any relief except for the massage which was of temporary benefit at first.

1. Massage.
2. Vibratory massage.
3. Flushing by bandaging and constriction.
4. Iodide of potash.
5. Mercury.
6. Nitroglycerine.
7. Partial restriction of activity.
8. Douches of hot water and alternating hot and cold douches.
9. Strychnine.

He remained under Dr. Warren's care during his convalescence from operation and went home in 2 or 3 weeks.

May 10, 1905, he again appeared, complaining of beginning symptoms in the right foot and was seen by my partner, Dr. James S. Stone. He was on crutches and of course was using the right foot a good deal. For about 7 weeks he had noticed on walking fast that there was stiffness in front of the fibula which extended to the middle of the calf where there was pain, slow walking was not painful. He was not wearing a plate but a foot pad. There was pulsation in the posterior tibial but not in the dorsalis pedis, the circulation was good at the inner side of the foot but poor at the outer side. There was induration at the middle of the inner border of the gastrocnemius and at the outer side of the leg for about five inches up from the external malleolus. The extreme gravity of these symptoms, which were almost identical with the early ones in the other leg, was recognized and a medical opinion was sought; a careful examination of the urine showed nothing abnormal and the heavy metals were absent. The consultant advised a vegetable diet and an open-air life and gave a fatal prognosis probably within 6 months. The patient was forbidden to walk except a few steps a day.

A month later (June 8, 1905) he reported, saying that he had not walked 25 yards in the last 4 weeks. He was sleeping out of doors and had little or no pain. His general health was better and the induration in the calf was less, his routine was not changed. In July he put on his artificial leg as it was desired, in walking, to take some weight off of the troublesome leg. In August he was put on Trunecek's serum, the formula of which is

Sodium Chloride	10.
Sodium Sulfate	1.
Calcium Phosphate	0.75
Magnesium Phosphate	0.75
Sodium Carbonate	0.40
Sodium Phosphate	0.30

Make 13 powders. Take one powder in one tablespoonful of water before breakfast and lunch.

For a period of 5 months from the beginning of the trouble in the right leg he was kept on this routine and walking was not allowed except to a very limited extent toward the end of the period. He improved steadily and in November, 1905, he was walking without crutches, using his artificial leg. At this time the induration in the calf had disappeared and the circulation in the foot had become apparently normal. At this time he resumed his occupation but in a form that required less walking. On July 28, 1906, 14 months after his first consultation on account of the right leg he was examined. He works from 8 A.M. to 6 P.M., mostly on clerical work and he has not lost a day in the last nine months. He has no pain unless he hurries, when there is a sense of tightness and discomfort in the calf. Pulsation is present but not good in both arteries of the foot and the circulation is apparently normal so far as one can judge from the color of the foot.

The case is of interest as indicating the line of treatment and as offering hope of at least an arrest of the disease by rigid measures. It resembles very much a case reported by Erb in which a similar arrest took place but in addition to moderate rest Erb used massage and measures to restore the circulation which in my patient proved useless in the first leg affected. It shows, however, that one may look for improvement in the arterial condition as shown by the return of the pulse in the dorsalis pedis artery.

CASE 2.—Mr. Y., a man of 60 years weighing about 250 pounds, about 5 feet 8 inches in height with small feet, consulted me on Dec. 7, 1905. He was a man of florid aspect and sedentary habits engaged in active business, his general health had always been good, he smoked pretty freely but was temperate in other respects. His history was as follows: On July 17, 1905, he was obliged to climb a steep hill in which he found difficulty and was conscious of a strain in the back of his legs. Pain in the right calf followed and walking was uncomfortable and he limped; he could walk for a little way but was soon seized by a cramp which compelled him to stop and after resting he could go on again; his symptoms were confined almost wholly to his right leg. He diminished the amount of his walking and the symptoms slowly improved and when he saw me had nearly disappeared in the leg originally involved, but a week before consulting me, similar symptoms had come on without known cause in the left leg and were giving him much discomfort. He had worn plates and foot pads, he had been baked and massaged, but nothing had given him relief and massage increased his pain. His symptoms were more or less constant pain in the foot and leg aggravated by walking and necessitating frequent rests, severe spontaneous pain at night and a sensation of coldness at night, pain on first letting the leg hang down and a sensation of numbness in the second and third toes as if they were "bound up in cobwebs."

The foot was small and markedly arched and the whole foot highly tipped over on the inner border during weight bearing. It was not noticeably swollen but the toes, especially the middle three, were blanched and of an entirely different color from the rest of the foot; even when the leg was allowed to hang down for some time they did not become a normal color. Pulsation in the posterior tibial and dorsalis pedis arteries was absent and there was a tender swelling in the middle of the calf over the course of the posterior tibial artery. The arteries were not noticeably hardened and an excellent X-ray picture did not show the arteries; the urine was normal.

The condition was diagnosticated as intermittent limping and the patient was put to bed. He was kept extremely quiet for three weeks and was not allowed to put the foot to the floor nor to let it hang down. His symptoms all improved slowly from the onset and at the end of three weeks he was allowed to go down stairs on crutches. He was given very large boots with high arches, which made no constriction at the front of the foot, but plates and pads to support the arch of the foot were not comfortable. At the end of five weeks he was allowed to walk a few steps without crutches. At this time very gentle massage was begun but proved irritating and was abandoned until two or three weeks later when it was resumed with success. There was present at this time a constant area of numbness of the skin at the inner border of the front of the foot which corresponded not to the distribution of any one nerve but apparently to the distribution of terminal arteries. He gradually increased his walking, the circulation became normal, and now he walks with a cane with some discomfort in the calf and some numbness in the toes but with steadily increasing comfort and a disappearance of active symptoms.

The points of interest in the case are the appearance of the symptoms from trauma, and over-weighting of small feet, and their improvement under treatment by rest with no medication beyond a restriction of diet, a limitation of smoking and a loss of body-weight induced by the change in the diet.

Case 3.—Miss Z. In Oct., 1904, there was referred to me by a neurologist a young lady of neurotic temperament on account of an irritable hip and knee on the right side apparently due to flat-foot. She had been under the care of one of my colleagues and had worn plates. Her gastrocnemius was very short and with the leg extended the foot could not be dorsally flexed to a right angle. The gastrocnemius was stretched and from time to time in the next 18 months she came on account of pain in the calf, knee, leg, or hip always accounted for by increased irritability of the gastrocnemius. Stretching of this muscle, massage and vibration relieved her symptoms each time.

On Feb. 5, 1906, while on horseback the left foot was forcibly plantar flexed as she was run into by another horse; it swelled and became painful at once and a sprain of mild degree was diagnosticated after an X-ray had been taken. It was massaged and baked but was overused and did not improve. On Feb. 16, 11 days later, it was put up in plaster-of-Paris and crutches were prescribed. Pain and a sensation of coldness began to be felt in the night and three days later the toes began to swell and to become bluish and the bandage was removed. The circulation of the foot now became better but was not normal. Pulsation was present in the arteries but the foot became violet or purple if allowed to hang down and never, even when raised, became of a normal color.

The ends of the toes showed the most marked discoloration, there was some swelling. Rest was insisted upon and the circulation gradually improved but whenever massage was tried it proved irritating. I was seriously apprehensive about the outcome but a physician who saw the case in consultation thought it merely a temporary disturbance of no great consequence and proved nearer right than I, for by the middle of April, about 10 weeks after the accident, the foot could be used moderately although the circulation was not then quite normal.

Here then were three types of cases. 1, a young man with general arterio-sclerosis or obliterating arteritis resulting in gangrene; 2, a man past middle age without conspicuous arterial change recovering from arterial obstruction; 3, a woman with a venous rather than arterial disturbance more amenable to treatment than the other two cases. One has only to look up the literature of the subject to recognize that cases of various types, of which these above may be taken as representative, are reported, but that the symptoms are on the whole uniform and point to a deficiency of blood in the leg.

The treatment of absolute rest until the circulation is restored seems the safest course to pursue.

It would seem worth while to call your attention to the importance of paying more than casual attention to disturbances of the circulation in flat-foot when they reach any noticeable degree. Associated with pain and induration in the calf and absence or feebleness of pulsation in the dorsalis pedis and posterior tibial arteries such disturbances of circulation warrant grave anxiety.

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DISCUSSION.

DR. JOEL E. GOLDTHWAIT, of Boston, said that it was hard to conceive of a more perfect presentation of a subject than Dr. Lovett had given this morning. He would however like to call attention to two points which might be emphasized. He had seen five or six cases of this type of trouble. One thing very suggestive had been the regularity with which pain had been produced. The patient would walk one block or a definite distance, at the end of which the pain would quite regularly develop. Another point is the extreme degree of pain in these cases at times resembling an attack of tic douloureux more than anything else.

DR. RIDLON, of Chicago, said that he would be glad to have Dr. Lovett tell the Association if in any of these cases there had been any œdema. He asked the question for a personal reason, namely: Two months ago he was suddenly attacked with stiffness, soreness and pain on motion on the anterior surface of the lower half of the right leg, and the whole leg from the tarsometatarsal articulation to the knee was œdematous. He was examined by Drs. L. L. McArthur, Arthur D. Bevan and William Allen Pusey and no satisfactory diagnosis had been made. The treatment was by a flannel bandage, and recovery occurred after three or four weeks Dr. Ridlon said that he had been subject to angioneurotic œdema at times for many years. These attacks had been mainly of the palms of the fingers or hands, and he wondered if these conditions from which he had suffered had any relation to the disease described by Dr. Lovett.

Dr. Reginald Sayre, of New York, said that Dr. Lovett's paper recalled to him three cases he had seen and which he had not been able to follow to an ultimate conclusion. The patients got very little benefit from his treatment. Two of these were men about sixty years of age. The other, a younger man about thirty-five years, was a Jew. They were all foreigners. They all had the history of pain coming on after walking one or two blocks. On stopping the pain passed off but the pain and disability came again when they resumed their walk. One case had cold feet but the others did not present evidence of interference with the superficial circulation. He did not feel sure that the case was one of obliterative endarteritis. It appeared to him more of a spasm of the blood vessels. Potassium iodide and nitro glycerine had not in these cases done anything special He had another case in mind somewhat similar. A man sprained his foot or thought that he did as sharp pain came on. The toes became dark. Inflammation and discoleration and œdema in the first foot cleared up shortly after but the same thing occurred in the other foot. This went on to gangrene and consequent amputation of the thigh at the hands of another surgeon. Subsequently emboli caused paralysis. In this case the trouble seemed to be an obliteration endarteritis. Antisyphilitic measures did not seem to be of use. The patient was in bed continuously while under observation.

Dr. A. H. Freiberg, of Cincinnati, said Dr. Lovett's paper ought to be highly instructive. Some time ago Dr. Peckham read a paper before the Association on "Flat-foot." He found it difficult in some cases to relieve flat-foot completely by mechanical measures. Every member of the Association has probably encountered cases difficult to handle that were the subjects of flat-foot. Dr. Freiberg expressed the view at the time that Dr. Peckham read his paper, that if complete clinical examination were made the trouble in these cases would usually be found to be more than static. Dr. Freiberg thought that every Purdy static case should be relieved by proper mechanical measures and the other means usually used for these troubles. The symptoms which we usually see in static foot troubles are to be attributed to the use of the foot. When the patient remains off the foot the symptoms vanish. Where this is not the case it is advisable to examine the case very thoroughly to ascertain whether there is not some other condition present to explain the condition, not to be regarded as static. It had been his experience on two occasions to have cases referred to him which were obviously normal as far as the mechanism of the feet was concerned. Both cases were referred by a neurologist. Dr. Freiberg gave as his decision that the trouble was not static but only secondarily so. The primary trouble was arterio-sclerotic. The one case he had in mind he did not get an opportunity of seeing again. He treated the case with apparatus but did not see the case long enough to know whether relief was complete. In the second case the foot had to be amputated after Dr. Freiberg had refused to give him a support. The man had very flat feet. He had been a clothing cutter for many years but the symptoms were not static. He was evidently arterio-sclerotic. No support was applied. He was given regular medical attention and some time after gangrene occurred and amputation became necessary. In another case that he had not been able to relieve, he had not used any of Dr. Lovett's measures except recumbency and that was used for a long period. There was not much relief, and there was obvious static trouble. It was the case of a young man about twenty years of age. This paper of Dr. Lovett's should be very helpful indeed and the surgeon ought to be more aware than he is that the presence of static faults in the foot does not necessarily imply that the pain and symptoms are due to the static fault.

Dr. R. W. Lovett, of Boston, closed the discussion. He said in reply to Dr. Ridlon that the element of œdema was not conspicuous. It was present in cases such as would be accompanied by arterial disturbances. The œdema was not an important factor. Replying to Dr. Goldthwait, Dr. Lovett said that he should have emphasized the regularity of the limp. A patient could walk a certain distance one week and next week he could walk a little farther if he were better. The constancy of limitation is almost characteristic. No patient with resistant flat foot leaves Dr. Lovett's office without having his dorsalis pedis and posterior tibial arteries examined. He believed the ordinary measures, nitroglycerine, massage, etc., to be useless. There is only one treatment and that is absolute rest. When he has talked the matter over with the patient and told him that not taking rest may involve the loss of a leg, he has not the slightest difficulty in getting the patient to take rest.

III.

THE TREATMENT OF FAULTY WEIGHT-BEARING IN "WEAK" AND "FLAT" FEET.

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It is with great hesitation that one ventures to discuss the treatment of static foot conditions. So much has already been written on the subject by masters of the art that triteness can with difficulty be avoided. And yet the opportunity to watch the treatment of these conditions in five large clinics, both private and public, has led to the belief that routine is largely the order of the day. One justly famous orthopedic surgeon, with a very large foot clinic, never applies a foot brace of any kind to a purely static error, and manages to accomplish his ends, and to satisfy the majority of his patients. Another equally famous man practically never treats a case of faulty weight-bearing without the application of a flat-foot plate.

The routine varies, to be sure, and the different routines have different points of value, but the evil of routine still exists in both.

The common conception of the laity, that a weak, painful foot means a fallen arch, and that an artificial one must be obtained and worn forever afterwards, like a set of false teeth, is due largely to this very routine on the part of orthopedic surgeons.

That this conception is wrong needs hardly to be emphasized theoretically, but practically the need of reform in our treatment of weak feet and faulty weight-bearing is, to our minds, a crying one.

The conclusions drawn from observation of these five clinics, three of them covering a period of several years, may be briefly stated as follows:—

1. That a rigid arch supporter worn for several months,

while relieving symptoms in the majority of cases, weakens the foot and tends to make the wearer dependent upon it.

2. That the prolonged use of such rigid supports is, in the great majority of cases, unnecessary, if proper treatment is administered at the appropriate time.

3. That the aim of the surgeon should be to strengthen the weak structure, and not simply to temporarily relieve symptoms.

4. That in the cases of simple weak foot the calcaneo astragaloid articulation demands most attention.

5. That in the severe cases of long standing, operative measures may be more commonly employed and offer lasting relief.

To define terms is, perhaps, unnecessary, but the confusion in their use, in some of the literature, makes it seem wise.

Valgus and Varus are, of course, too well understood to need more than the adjectives rigid, or flexible, as prefixes, to make them descriptive. The word "Pronation" is used to describe a condition of faulty weight-bearing which consists of an apparent sagging of the internal malleolus and an eversion of the foot, which brings the line of weight-bearing too far to the inner side. The arch may be affected only in so far as the eversion lengthens the inner border and so diminishes the height of the arch.

"Reserve Pronation" is a useful term first used by Drs. Lovett and Cotton to describe the ability of some persons with already pronated feet to still more pronate, by relaxing certain muscles, showing that there was still considerable power in the muscles to partially overcome the pronating tendency. Supination may be defined as the opposite of Pronation.

Certain essential anatomical points may well be discussed early, since their significance is important in relation to treatment. As has been shown by Drs. Lovett and Cotton in a series of interesting experiments, the joint at which most of the pronation takes place is the calcaneo astragaloid. The calcaneal facet is roughly dome shaped and slopes downwards from behind forwards. On this the astragalus may partially rotate and slide downwards.

The astragalus, held as it is in the mortice of the malleoli, must carry the leg with it, or else the whole foot must be conceived as rotating on the astragalus into a position of valgus. To determine for one's self the fact that at this joint most of the pronation occurs, the following experiments may easily be tried. In the flexible foot of a cadaver the amount of possible pronation is measured. A wire nail is now driven transversely through the malleoli and astragalus, thus immobilizing the ankle joint proper, as to lateral or rotary movement of the astragalus on the tibia. The pronation now measured is found to be approximately the same as before.

A second wire nail is now driven through the scaphoid into the astragalus, thus locking the medio tarsal joint. The possibility of pronation is still very marked. So one may go on immobilizing the other articulation with the same result until a long nail is driven from below upwards through the oscalcis into the astragalus, when the possibility of pronating the foot will be found to have almost entirely disappeared.[1] If one removes the other nails, the same inability to pronate remains, as long as the oscalcis and the astragalus cannot move on each other.

By a study of many ligamentous wet specimens of the Anatomical Laboratory of the Harvard Medical School, the strength of one ligament, the calcaneo scaphoid, was emphasized. Like many other facts mentioned in various descriptive anatomies, the importance of this structure was not realized until studied in the dissected specimen. This broad tough band forms the floor of the astragaloscaphoid joint, and carries the scaphoid and the longitudinal arch downward, as the rotation and descent of the astragalus on the calcaneal facet occurs in pronation.

As Lovett and Cotton have shown, the relations of the articular surfaces cause an outward movement of the scaphoid when the head of astragalus rotates inwards, and the fore part of the foot follows "en masse" the scaphoid.

If the scaphoid and oscalcis are fixed in relation by the contraction, for instance, of the tibialis posticus, no rotation of the astragalus can take place. There are no muscular insertions on the astragalus which is the sole transmitter of the body weight.

A brief review of the muscular actions is appropriate in relation to the discussion of exercise treatment of weak feet. The tibialis posticus, whose tendon lies in a groove beneath the internal malleolus, most perfectly overcomes pronation by pulling inward on the tubercle of the scaphoid, fixing it in relation to the oscalcis, and preventing the rotation of the astragalus. It is a weak plantar flexor of the foot, but when its contraction is simultaneous with that of the tibialis anticus inserted into the internal cuneiform and a strong dorsal flexor, inversion and dorsal flexion is the result, and pronation changed to supination.

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[1] Trans. Am. Ortho. Assn., 1898.

The peroneus longus and brevis swinging round the external malleolus, the former running across the sole of the foot to the base of the first metatarsal or interior cuneiform, and the latter inserted into the base of the fifth metatarsal, together with the peroneus tertius are the strong everters of the foot and favor pronation and the valgus position.

The other leg and foot muscles seem to influence to a comparatively slight degree pathological pronation or supination.

I.

Feet demanding treatment for static error at once divide themselves into two great classes, Flexible and Rigid.

The former are far more easy to correct and never need operative measures. The rigid ones, on the other hand, nearly always demand either bloody or bloodless surgery, and must, in some way, be rendered at least fairly flexible before the symptoms can be completely relieved.

The flexible weak foot, in the vast majority of cases, represents simply an over strain. One is generally rewarded by discovering the underlying cause for this, if a patient search is made. If, on the contrary, after the manner of early medicine, we attempt simply the relief of symptoms, our ignorant patients will often thank us for a freedom from pain which is in reality a bondage of steel.

The general physical tone of the patient should be our first consideration. A relaxed debilitated condition makes itself evident at the point of least resistance and the strain of weight-bearing, owing to our universally constricting and imperfect shoeing, is most keenly felt in the feet.

No matter how perfectly our appliances fit, no cure can be effected until the proper muscular and ligamentous tonicity is established. The cause may be found to lie in an occupation which puts constant strain on the ligaments, in a rapid or gradual increase in weight, or in a change from an inactive to an active life. Unless this etiologic factor be discovered, treatment will be as imperfect as our investigation has been superficial.

Expediency may at times demand the sacrifice of an ideal, and long-standing conditions offer only the opportunity for relief and not cure, but we feel very strongly that these justifications of palliative treatment should be more seldom accepted, and that they often represent excuses and not scientific reasons.

Simple Weak Relaxed Feet.

The terms, "Flat-foot" and "Broken arch," have caught the public fancy, and the attention of the laity has been directed to the feet. This has undoubtedly diminished the ingestion of sodium salicylate, and has helped humanity in another way by stimulating people to consult orthopedic surgeons in the early stages of faulty weight-bearing.

Hoffman has conclusively shown that there can be no absolute standard of the height of the arches. This varies in different individuals within wide normal limits. It is to be remembered that a normally high arch beginning to suffer strain is vastly more painful than an arch absolutely much lower but normal for the individual, and that the early pain is often more severe than after the ligaments have been stretched and the foot "settled" somewhat.

In these early cases where the longitudinal arch without weight-bearing is normal for the individual, and where the pronation is slight, we feel there should be no application of a rigid plate. A search for the underlying cause should be made, and temporary rest of the strained structures secured, either ideally, by freedom from all weight-bearing, or by the application of a carefully fitted spring plate, or a Thomas heel, or a combination of both. By a spring plate we mean an accurately shaped brace made from a cast taken without weight-bearing, of 21–26 steel or of celluloid, and slightly higher than the arch. This allows the foot some action in walking, and gently applies restoring pressure when at rest.

A Thomas heel by propping up the oscalcis, and preventing the rotation of the astragalus, while the front of the foot is inverted in weight-bearing, will often relieve the strain and accomplish the purpose.

After the tired structures have been rested for a few weeks, and the underlying cause combated, massage of the feet and lower leg muscles should be given, and in a few days the exercises enumerated below begun. If resistance may be had in these exercises the end is accomplished more quickly. The patient should be encouraged to gradually give up the spring appliance, if one has been used. The Thomas heel should be worn for several months, the elevation on the inner side being gradually diminished. It is perhaps needless to emphasize the necessity of obtaining at the outset shoes which do not contract the feet, and are sufficiently flexible to allow corrective muscular action.[1]

PRONATED FEET.

With class "B" much the same course of treatment is advised. Here the pronation seems the essential feature, and "reserve" pronation is very slight or entirely absent. Occasionally in this class a rigid plate, preferably of the Whitman type, should be furnished for the first few weeks of treatment. The Thomas heel, carried, perhaps, a half-inch forward on the inner side, and raised one-quarter of an inch more on inner side than the outer, should be worn for a period, the length of which should be determined by the response of the muscles to exercises, and the return of the reserve pronation. Exercises are here the most important element in accomplishing a permanent relief.

Class "C" includes those cases, fortunately more rarely seen, of pronation plus valgus, where the longitudinal arch, with and without weight-bearing, is depressed and tender to plantar pressure, where there is no reserve pronation and the eversion is most marked. These feet are more difficult than others of the flexible type to permanently relieve, without permanent apparatus of some kind. We believe that tendon transplantation is worthy of serious consideration in some of these cases, though we have lacked opportunity to attempt it. A rigid support is practically always required at the start, planned not only to overcome pronation, but to prop up the relaxed and stretched arch. The plate should be made only slightly higher than the weight-bearing arch at first, and then, at two or three week intervals, gradually raised, until an approximately normal height for the individual has been attained. The wearing of the rigid plate should now be limited to the hours when most strain of weight-bearing is borne by the feet, and a high spring plate substituted.

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[1] Journal Am. Ortho. Assn., July, 1905.

Under exceptionally faithful and long continued massage and resistive exercises, we have seen such feet improve in contour, regain much of their normal arch height, and be able to stand much hard use eventually, without the help of plates.

Such devotion to treatment is seldom found, however, when it entails so much expenditure of time and energy, and relief can be had by the constant use of the supportive apparatus.

II. (D) METATARSALGIA.

The history of a typical case of metatarsalgia, or Morton's toe, is so characteristic that little doubt can be had as to the diagnosis. A scientifically accurate description as to the causative factor is still lacking. That it is associated with a relaxed anterior arch, and especially an abnormally movable metatarsal head, usually the fourth, seems unquestioned. The response to treatment is to the physician at times a matter of doubt, though, when successful, often seems to the patient little short of miraculous. This condition is practically confined to the flexible type of feet and is relieved if we restore the transverse arch, and succeed in sufficiently immobilizing the head of the offending bone or bones.

If this condition is met in a case of weak foot demanding plate treatment for the longitudinal arch, an extension of the support under the anterior arch will usually relieve. If the symptoms are referred only to the front of the foot, the correction of the probable slight pronation, together with a light support of anterior arch, is our best procedure, since we can thus better hold the latter. A light spring pad is often sufficient.

Not rarely, no support from underneath alone, gives perfect relief, and restoration of the arch, by lateral compression of light spring steels attached to the plate, or by elastic as unyielding bandaging, has been necessary.

We should look to exercise, active or passive, as our rational cure, though long persistance in them is usually necessary and does not offer lasting relief in all cases.

Obstinate forms will be encountered which fail to yield to supportive and gymnastic measures, and we must fall back on the excision of the metatarsal head as an almost sure relief from the distressing intermittent pain.

III. Rigid Feet.

General Consideration.

The difficulties in the satisfactory treatment of rigid feet as a class, while by no means insurmountable, will be reognized by all as considerable.

Weight-bearing determines that the deformity, in practically all cases, shall be valgus, and the problem presented is to obtain a completely or partially flexible foot, capable of maintaining, without or with artificial support, correct weight-bearing lines.

The social status of the patient determines in some measure the extent to which our treatment can be carried, since on the leisure and persistance of the individual depend largely the success of our treatment.

It is also at once obvious that the amount of use to which the feet are to be subjected must influence the extent of our correction. Thus, when a constant future strain of walking or standing is inevitable, we must be more determined than when a more or less sedentary life is to be led, and freedom from acute discomfort is the only boon sought.

(A) Muscular spasm or actual muscular contracture.

We must determine first whether the rigidity of a foot is due to simple muscular spasm, to actual muscular contracture, or to adhesions, fibrous or bony. Often an examination without an anæsthetic may determine this part, but our own experience has taught us that it is best in most cases to advise an examination under an anæsthetic, having obtained the consent of our patient to any corrective measures which at the time may seem wise.

The simple muscular spasms will disappear under a full anæsthesia. Contractures will be little influenced, and adhesions not at all. The commonest form which we have seen has been the spasm of the peroneals, and, although the foot be markedly over corrected and retained for a long time in plaster, the tendency to recurrence has made these in our hands a most unsatisfactory class to treat. Even if tenotomy be performed, this recurrence is only delayed.

On the other hand, in those cases in which, after the method of Mr. Robert Jones, an incision of 1–1½ inches has been made over the tendons just above the malleolus, and about ¾ to one inch of the tendon sheath of the peroneus longus, and the same extent of the tendon and partly muscular portion of the peroneus brevis has been excised, a recurrence of the deformity has been extremely rare, and no disturbance of function has resulted. The foot is fixed in plaster in an over corrected position for a month, and then weight-bearing is begun with a Thomas heel. Repeated stretchings by the Schaeffer shoe has been found most efficient in overcoming contractions of the Tendo Achillis.

Where, in the rigid valgus cases, tendons are found to be actually contracted, they should be divided. In the rare types of contracted feet, where the Tendo Achillis is usually short, a tenotomy, or better, a lengthening of the tendon, should be undertaken.

We have lately followed two cases of extreme muscular spasm treated by corrective adhesive strapping and daily exercise in the Baumgartel universal foot exercising machine.

The limbering out began after the first treatment; was complete after three or four, and after over a month the feet have remained flexible and symptomless.

Whether this machine will supercede the operative precedures the future alone can tell. That it deserves fair trial is undoubted.

(B) In those cases in which the rigidity is due to fibrous adhesion, from the strain of static error, the inflammatory processes of infectious arthritis or the results of trauma, forcible manipulation under an anæsthetic is almost indispensable. If one is the fortunate possessor of strong hands, this may be done manually, but the wrench of Thomas, if one is dextrous in its use, is usually more thorough and efficient. The long continued uninterrupted fixation after this over correction we feel is unwise and unsatisfactory in result.

Within 24 or 48 hours the cast should be split, and the feet at first gently and later more vigorously moved, being returned to the retentive over correcting cast. Within a week active exercises should be begun, and these procedures, uncomfortable as they often are, including, if necessary, the anæsthesia, should be persistently repeated until the desired flexibility is obtained and can be retained under use. A supportive and corrective plate is usually a necessary addition to the treatment.

(C) When the rigidity is due to bony ankylosis or over growth, we are confronted with a much more serious condition. Very forcible manipulation and wrenching under an anæsthetic may result in bettering the position, but will hardly restore flexibility.

If the obstruction to motion is caused by bony spurs which have their etiology in some septic or inflammatory lesion, their removal by open incision offers a chance of return to more normal motion. If the spurs are the result of a chronic rheumatic process of the hypertrophic type, we have no warrant that their removal will not be followed by their recurrence, and palliative measures are surely wiser in most cases.

If tarsal fracture is demonstrated by the Rœntgen ray corrective osteotomies, in suitable cases, are the rational procedures. Not a few cases have been met in which, from long weight-bearing-strain, the head of the astragalus and sometimes the scaphoid have partially subluxated, and bulging on the inner side, represented bony obstacle to correction, and a trying deformity. In three of these cases, now followed for three or four years, removal of the scaphoid has been performed, and by forcible manipulation, the inner border of the foot shortened. One of these cases was in a waitress who now is free from symptoms, with a partially flexible foot and a correct weight-bearing line. The other two are able to do house-work without discomfort, and none of the three wears plates.

Much has been written on the operative treatment of hallux valgus and hallux rigidus. We believe that the Heuter operation of removal of the over-grown metatarsal head, is almost uniformly satisfactory, when a proper operative technique and after-treatment have been observed.

IV. CONCLUSIONS.

The exercise treatment of weak feet is admitted by all to be rational and desirable. That it is much neglected in much private work, and practically unemployed in most hospital clinics, we feel sure. The blame for this cannot be wholly laid at the physician's door, for, in the busy lives of today, a fifteen minute earlier rise in the morning and a delay of the same time on retiring represent a serious inconvenience. In private work, by regular office appointments, we can have this exercise treatment supervised by ourselves or our helpers, and should make the patient feel that it is as important as our exercise work in scoliosis. The exercises advised by Ellis[1] are admirable, and can be supplemented by others of the same nature but offering variety.

A very simple and effective foot exerciser can be made from a piece of plank about a foot square with as light depression, acentric, in which the heel rests. Screw hooks are placed at appropriate places on the edges, a webbing strap, to which a stout hook is sewn, is placed about the foot just back of the great toe joint. A wire spring 2 to 3 inches long is now caught by one end to the hook in the plank edge and by the other to the hook in the webbing strap. By changing the insertion of the spring, resistive foot exercises may be taken in inversion, eversion, dorsal and plantar flexion and curling the toes. For dorsal flexion a block is added in order to gain more height from the floor for full plantar flexion. For plantar flexion an arch of stout wire with a loop in it for the attachment of the spring is inserted into two holes in the plank and allows the pull from above. We recognize that the spiral spring does not furnish the most perfect physiological resistance but the appliance gives the patient a definite object, and accomplishes more than exercises without apparatus.

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[1] Lancet, Sept. 25, 1886.

A more elaborate and perfect mechanism is the machine of Fr. Baumgartel, alluded to above. With this apparatus, it is possible not only to give appropriate exercises to flexible feet, but also, we believe, to limber many rigid forms.

Careful attention should be paid to the gait. The admonition which we probably all received from our own parents, to turn our toes out in walking, should be combatted, and, in its place, lessons in a straight, toe-forward, springy gait should be given.

APPARATUS.

We believe that in the future more orthopedic apparatus will be corrective, and less simply retentive. The principle of the spring is applicable in many cases, and gives results not to be obtained by rigid apparatus.

As an example: Plates made of light steel, carefully tempered, of 21–26 gauge, and covered with compress cloth painted with several coats of an acetone solution of celluloid, are extremely durable and comfortable, giving relief to symptoms in the common mild cases of foot strain, and producing none of the atrophy and subsequent weakness, which nearly always results from the rigid plate, with the possible exception of the Whitman brace.

In certain cases, in which night supports are advisable, to increase inversion, a valgus shoe has been made, having a lateral hinge joint just below the antero-posterior stop joint. A spring is stretched from the front of the sole plate to the calf band, and thus dorsal flexion and inversion maintained by a constant pull, the strength of which can be regulated by the stiffness of the spring.

Proper shoes are the most important form of apparatus. Through co-operation of manufacturers and orthopedic men, several lasts which are made on good non-constricting lines and are fairly flexible are to be had ready made. For the active hours of the day we should insist that shoes which favor slight adduction of the fore foot, and give wide space for toe action, should be worn.

Operative Methods.—If the removal of the metatarsal head is undertaken for over growth of the first or fifth, or for obstinate metatarsalgia cases, the gigli saw is undoubtedly most useful. These bones have no support against which the chisel can be pounded and are prone to sliver. They also often splinter when bone cutting forceps are used. Spur pronation is thus favored. A stout carrier with a notch in the end has been devised which may be forced close about the bone, the eye of a fine gigli slipped into the notch, and the saw drawn about the bone. The skin edges are protected by light grooved retractors, and a smooth division of the bone accomplished. The subsequent swelling is always surprising, and better results are always obtained if the case is treated much like a fracture and 2 to 3 weeks of freedom from weight-bearing insisted upon.

It has taken long to say very little, and yet we feel that this subject demands more detailed attention than we often bestow upon it.

Relief of symptoms is usually so easy that after-treatment is neglected, quite as readily by the patient as by the orthopedic surgeon. With few exceptions rigid supports should be looked upon as temporary measures and return to normal function without apparatus should be the end result of our treatment.

IV.

THE SIMPLEST MECHANICAL METHOD OF TREATING COXITIS AND ITS RESULTS.

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The ideal end, ***Restitutio ad integrum***, can only be obtained in a small percentage of very mild or abortive cases.

Generally after the local process has subsided the joint is ruined both anatomically and functionally. Particularly is the activity of the important pelvo-trochanteric muscles entirely lost, on account of the luxation of the head of the femur and the shortening of the lever arm formed by the neck, to say nothing of the cicatricial contractions and the atrophy of the muscles caused by lack of function. Following this irreparable muscular change, the ability to maintain the pelvis in a horizontal position on the diseased side is lost. Every step accordingly furthers the formation of adduction contractures which brings to naught the long years of effort to maintain the leg in good position, if the mechanical treatment should finally be given up. This commonly adducted joint which is limited in motion is frequently painful (the patient has intercurrent attacks of pain), the patient's endurance is limited and he limps decidedly. I have observed that a movable joint, after the process has healed, is not a desirable end result of the mechanical treatment. I much prefer a fixed joint, bony ankylosis, with the limb in extended position.

Besides relative unimportant disadvantages, the ankylosis offers the patient unlimited endurance, regular walking without sensitiveness or pain and exclusion of every danger of traumatic relapse.

The accepted treatment with extension does not tend to ankylosis as a final result, hence from this standpoint it is inadequate.

Moreover the extension by continued use is detrimental, as it causes a very marked degree of inactivity, atrophy, and prohibits every function of the leg.

The necessarily repeated correction of the slight adducted position which in spite of extension in walking so frequently develops is likewise detrimental to ankylosis, so that we can say that the mechanical treatment presents a constant battle against the tendency to adduction. Eventually when treatment ceases or within a very short period, as a rule, adduction again occurs.

The extension treatment is founded on the supposition that the diseased joint is intolerant, first to body weight during the sensitive period and secondly is sensative to motion. The supposition was so far reaching as to regard motion as the essential function of the joint for its conservation and not alone allowable but even beneficial, and that extension was sufficient when not bearing weight. But daily experience has taught us that just the opposite is correct, namely, that the joint during the greater part of the disease is but slightly or not at all sensitive to body weight. On the contrary the joint from the very onset of the disease is very sensitive to motion. This fact allows a great simplification of the mechanical treatment which at the same time promotes, as the final result, ankylosis. This simple treatment consists of continual fixation of the joint from the beginning of the first symptoms until the process ceases and even for a period after the process has ceased.

The extension is replaced by the weight-bearing of the fixed joint, that is by the stimulus caused by the weight-bearing which the fixed parts (pelvis and femur) are subjected to.

It is not the exception that this fixation is in itself sufficient for the entire cause of the disease. Still, as a rule, during the height of the process, a more or less complete or even absolute rest of the diseased leg is desirable on account to the sensitiveness to weight-bearing. Continued excessive pain which through mechanical methods, by it extension or fixation or the combination of both that cannot be allayed is due to intraarticular abscess or the slow perforation of the capsule of the joint and either requires aspiration or incision.

The complete rest is necessary for a relative short period, one or two months. Soon, however, incomplete rest suffices, until the sensitiveness has been allayed and then fixation is again sufficient.

The correction of the adduction and contraction which generally occurs during the years of treatment is not combinable with the principle of continued fixation as long as the process has not healed. The indications for the orthopedic treatment have arrived when the patient is able to use the limb for a period of months without pain or apparatus.

The shortest method for obtaining this result is subcutaneous intertrochanteric (extraarticular) osteotomy which permanently corrects the adduction without danger of recurrence. This simple orthopedic operation can be performed in one's office and only inconveniences the patient for a few days, in spite of the fact that extension is not used and what is more, after the pain has subsided more or less weight-bearing is permitted. Coxitis with abscess formation (the smaller percentage of cases) is treated conservatively without iodoform on the same principle. The end result, ankylosis of the joint, the limb in extended position, is, as a rule, obtained by this simple mechanical treatment. One could call this simple mechanical method "the functional or the ankylosing treatment" on the principle that we always assign to the diseased leg as much function as for the time being is compatible with the degree of sensitiveness of the joint.

Physicians with large hospital practice who have many cases of coxitis to treat will soon appreciate the advantage of this method.

V.

A STUDY OF THE EFFECT OF PRESSURE ON THE CURVE AND ROTATION OF THE SPINE.

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The following experiments were made on a five and a twelve year old cadaver. They consisted of the usual methods employed for the correction of spinal deformity, namely, the prone sitting suspension, supine positions, in all of which the shoulders and pelvis were held by straps and pads such as are usually employed on the patient. Ninety-four experiments were made.

Before beginning each test, the seventh cervical and the lumbar spine were aligned, so that no lateral displacement of the spine, or twist of the pelvis or shoulders would be present to start with. Perpendicular alignments were made with reference to two plumb lines, against which a horizontal rod, kept horizontal by a level, rested; the point of the rod extending to the seventh cervical, that distance marked off, then lowered to the prominent lower end of the sacrum, and the same distance noted. No. I.

For horizontal positions two short projections of equal length from a horizontal rod were rested, one on the seventh, the other on the prominent lower end of the sacrum; by means of a level protractor, these were aligned, and by the same means the shoulders and pelvis were squared. No. II.

A four posted iron frame was used to secure the body in position. The shoulders and pelvis were each secured by padded steel against a steel rod; the ends of the steel rod resting on cross steel rods and secured by clamps, the cross steel rods being fastened to the posts of the steel frame. No. IV and No. V. It was possible by this method to accurately adjust the shoulders and pelvis and their supports, and hold them any length of time. By means of the two plumb lines, a level rod and a level protractor, alignments could be easily tested before each experiment, and the relation of each part carefully observed.

The following points on the spine were selected for measurements:—the seventh cervical, the fourth, eighth, twelfth dorsal, second lumbar and the sacrum, the position of the pelvis and shoulders.

The spinous processes were carefully dissected out without removing the ligaments or important attachments. It should be mentioned here that I am indebted for the convenience of their departments and other help to the courtesy of Professor Dwight and Dr. John Warren of the Anatomical Department of the Harvard Medical School, and to the assistance of Drs. Barnes, Coyne and Drowne in making the experiments. Each experiment and actual tracings, and records of the results, will be published. It is perhaps sufficient here to give an outline of the work. In making side pressure for twist or for lateral deviation, the same amount of pressure was made, and twice as much at a definite point measured from the spine, and in each position control was obtained by repeating each test on the opposite side of the spine. The effect of side pressure at different levels in a sitting position,

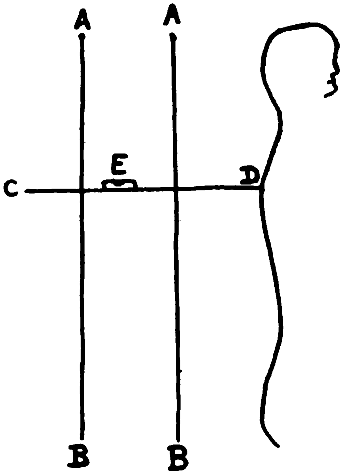

FIG. I, A B, plumb line; C D, iron rod; E, spirit level.

and of rotary pressure, first one side then the other, at different levels, the weight applied, and the force applied. These experiments were all noted with the cadaver on a hammock, suspended, and in the supine and sitting positions. The records are here, and can be looked over by those interested.

Tracings were taken by means of lead superimposed on a line around the chest, the line being at the level of the spines of the vertebra indicated. No. III. The relations of the body cross sections at different levels were determined by the instruments mentioned above, and dividers; as the body could be clamped into position, deliberate and minute measurements and tracings could be obtained.

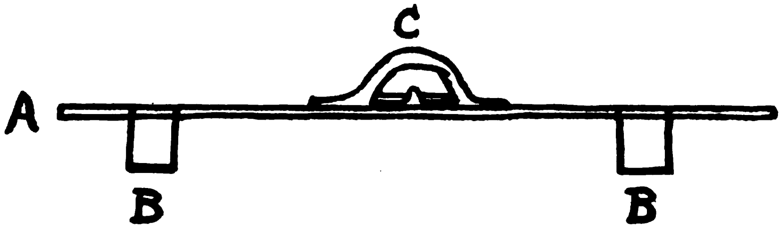

Fig. II. A, rod used for horizontal readings of inclination; B B, projections placed in contact with the points to be measured; C, level protractor, which gives in degrees the angle of inclination.

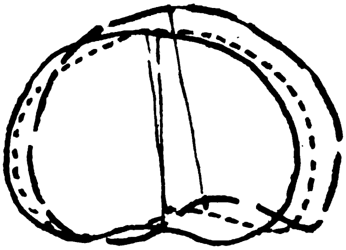

Fig. III. Tracing of the body superimposed to show their relative position as recorded in each experiment.

These and the control tests, with the alignments before each test, made the work necessarily long. The results were largely confirmatory of what has long been conjectured, but never experimentally proved, to be true. They are as follows:

The spinal column can be rotated by pressure on the ribs.

Slight pressure causes flattening with lateral bulging of the ribs.

More pressure causes flattening and lateral bulging of the ribs; and a rotation of the spine. More pressure still causes more rotation and bulging of chest anteriorly, also increased flattening and lateral bulging of the ribs. Pressure on ribs rotates the spine but not the spinous tips to the same extent. In other words, the inter-vertebral disks play an important part in allowing curvature and rotation.

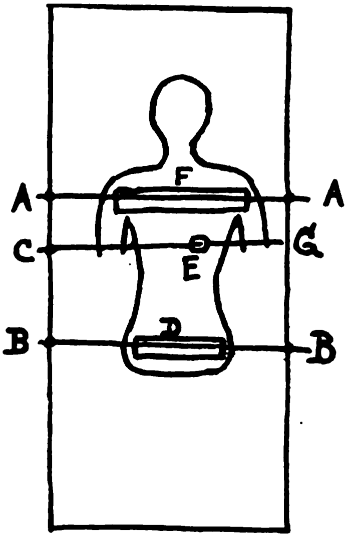

Fig. IV. Posterior view. A A, bar holding shoulders; C G, bar used as a lever with rib pressure at E; B B, bar holding pelvis; D and F, padded steel plates to which the shoulders and pelvis are strapped; G, points at which the weight was applied. The actual pressure at E is calculated for each experiment.

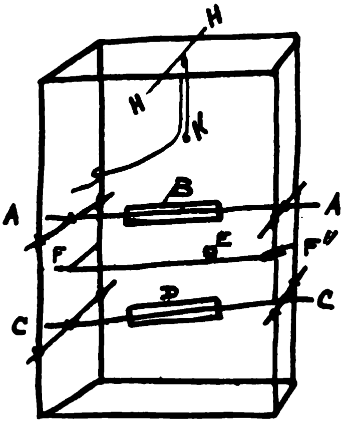

Fig. V. Diagram of four posted frame. A A, shoulder bar with padded steel B; C C, pelvic bar with padded steel D; F F, lever with pressure point E and scales at F″; H H, rod for head-sling pulley; K, hook.

The spine may be markedly rotated and curved, but the line of the spinous processes is not proportioned to the deformity.

In rotation of the chest, the anterior bulging is lower down than would be expected, as the ribs slope down and forward. This has been noted by Dr. Keene.

It was impossible to get a twist without some slight lateral deviation.

Lateral deviation was always accompanied by a very slight twist, not always shown by the spinous processes, but evident from the position of the bodies of the spine.

Such a slight amount of rotation was present with attempts at purely lateral deviation, and vice versa, that it is conceivable that purely lateral deviation, or simple rotation might be possible. Lateral deviation was greatest in the lower dorsal and lumbar spine.

Rotation of the Dorsal. For obtaining rotation, the recumbent position yielded more for a given pressure; due probably to the assistance of gravity, and to the decreased friction between the vertebræ. No proportionate relation could be determined, in curvature or rotation, by doubling the number of pounds' pressure at a given point. This was tried in all experiments.

With pressure at the sixth rib, rotation is greater at the eighth, than at the fourth dorsal, when the shoulders and pelvis are fixed.

FURTHER CONCLUSIONS.

For correction of high rotary curves, vertical positions may be employed advantageously; especially when the lower portion of the spine should not be affected by the treatment.

For correcting rotation where more correction is desired in front, supine position is most advantageous. For correcting rotation where more correction is desired behind, the prone position is more advantageous. Head pull is especially helpful for high rotation sitting where a vertical position is desired.

Suspension with toes touching is especially good for equal correction of both high and low rotation at the same time. A lying position is the most advantageous for getting the maximum correction with a minimum force.

In the treatment of scoliosis it is desirable to have definite data on which to base the principles to be employed. It has been assumed by some that rib pressure affected the rotation of the spinal column. This has been denied by others. The above experiments prove among other things that rib pressure is capable of being utilized as a therapeutic measure in scoliosis.

THE EXPERIMENTS ON CADAVRE.

ROBERT SOUTTER, M. D.

SERIES A.—Total height, 3 feet 2 inches; weight, 38 pounds; age, about 5½ years.

PRONE POSITION.

I 9 lbs. pressure at the level of the sixth dorsal, 2 inches from the spinous processes, right side.
II 18 lbs. pressure at left chest.
III 9 “ “ “ right “
IV 18 “ “ “ “ “

SUPINE POSITION.

VI 9 lbs. pressure at the left chest, upward.
VII 18 “ “ “ “ “ “ “
VIII 9 “ “ “ “ right “ “
IX 18 “ “ “ “ “ “ “

SITTING POSITION.

X 9 lbs. pressure at the right chest.
XI 18 “ “ “ “ “ “
XII 9 “ “ “ “ left “
XIII 18 “ “ “ “ “ “

STANDING POSITION.

Toes Touching, Head Suspension.

XIV 16 lbs. head pull, 9 lbs. pressure on right chest.
XV 16 “ “ “ 18 “ “ “ “ “
XVI 32 “ “ “ 9 “ “ “ “ “
XVII 32 “ “ “ 18 “ “ “ “ “
XVIII 16 “ “ “ 9 “ “ “ “ “
XIX 16 “ “ “ 18 “ “ “ “ “
XX 32 “ “ “ 9 “ “ “ “ “
XXI 32 “ “ “ 18 “ “ “ “ “

Recumbent Position Flex.

XXII	Upward pressure at 4th dorsal.
XXIII	“ “ “ 8th “
XXIV	“ “ “ 12th “
XXV	“ “ “ 2d L.
XXVI	Lateral flexion to left at 8th dorsal.
XXVII	“ “ “ “ “ 12th “
XXVIII	“ “ “ “ “ 2d L.
XXIX	“ “ “ right “ 8th dorsal.
XXX	“ “ “ “ “ 12th “
XXXI	“ “ “ “ “ 2d L.

Recumbent Position Prone.

XXXII	Lateral pressure at 4th dorsal, 25 lbs. on left.
XXXIII	“ “ “ “ “ 50 “ “ “
XXXIV	“ “ “ “ “ 25 “ “ right.
XXXV	“ “ “ “ “ 50 “ “ “
XXXVI	“ “ “ 8th “ 25 “ “ left.
XXXVII	“ “ “ “ “ 50 “ “ “
XXXVIII	“ “ “ “ “ 25 “ “ right.
XXXIX	“ “ “ “ “ 50 “ “ “
XL	“ “ “ 12th “ 25 “ “ left.
XLI	“ “ “ “ “ 50 “ “ “
XLII	“ “ “ “ “ 25 “ “ right.
XLIII	“ “ “ “ “ 50 “ “ “
XLIV	“ “ “ 2d L. 25 “ “ left.
XLV	“ “ “ “ “ 50 “ “ “
XLVI	“ “ “ “ “ 25 “ “ right.
XLVII	“ “ “ “ “ 50 “ “ “

Series B.—The same experiments on cadavre 4 feet 7 inches; weight, 68 pounds; age, about 12 years.

VI.

A NOTE ON A CASE OF CONGENITAL DEFORMITY OF THE SPINE, ETC.

BY J. JACKSON CLARKE, M. B., F. R. C. S.

Surgeon to the North-west London Hospital and to the City of London
Orthopedic Hospital.

Charles ——, aged 3½ years, from birth had held his head bent forward on his chest and the shoulders drawn up nearly to the level of the occiput. He could raise his eyes to the horizontal only by arching the body in extreme lordosis. His face presented a slight degree of the facial distortion seen in cases of anencephalous monsters and the whole attitude was reminiscent of that extreme error of development. The boy dribbled although he had been operated upon for "tongue-tie." He had absolutely no power of rotation, or lateral flexion, or extension of the cervical spine. He had been treated with an antero-posterior splint and massage for one year with very little improvement.

I suggested that it would be worth while to put the child under an anæsthetic and see if, by dividing muscles, etc., any improvement could be obtained.

This operation I did on May 10th, 1905. Previous to making an incision I could not decide whether sterno-mastoid muscles were present or not. I was pleased to find them and I divided each one on a director. The trapezius I also divided through an incision on each side, above the position of their nerves.

I was now able to bend the neck backwards with very little resistance and also to rotate the head from side to side. On completing these movements the patient at once became collapsed. I returned the head to the flexed position and holding it so had the boy inverted. The pulse returned, but was very rapid, hardly countable and he was put to bed with the head held bent forwards by the antero-posterior splint. For a week the pulse remained very rapid but it gradually slowed down to 120 on the seventh day after operation. The extension of the neck on the instrument was gradually increased and on June 22d exercises were very cautiously commenced. The following interesting phenomena were observed in doing them: (1) When the neck is extended, patient complained of pain in the epigastrium and the abdomen suddenly bulged from a sharp contraction of the diaphragm and the pulse increased from 108 (normal for the boy's age) to 122.

When the boy's head was turned to the left he had an attack of breathlessness.

By June 28th, 1905, these phenomena which evidently depended on the stretching of the nerves in the neck, were gradually diminishing and by the end of July they had almost ceased and the patient was able to hold up his head, without any lordosis, and to turn the head freely from side to side. This improvement is fully maintained at the present time, and the boy has a neck, though a short one, where he had none before. His dribbling has ceased.

Skiagraphs.

Study of a series of skiagraphs taken recently show the following points:

1. The presence of thirteen ribs, a cervical rib being present, on both sides of the body. (This feature is only clearly shown in one X-ray in which the lower ribs are clearly seen.)

2. A double lateral curve, to the left in the cervical, and to the right in the uppermost dorsal region. This curve accounts for the greater elevation of the right as compared with the left shoulder; thus part of the deformity is the same as that seen in cases of congenital elevation of the shoulder (Sprengel's deformity).

3. Appearances which indicate defective structure in the lower cervical and upper dorsal vertebræ: *a*, an unossified space in the front of the column; *b*, a fusion of the last cervical with the first dorsal vertebra, and, *c*, an increased width in the upper dorsal vertebra, as if the want of ossification referred to under 2 might be due to conditions similar to those which cause an anterior spina bifida.

It may be added that the boy is in vigorous health, and seems to be normal in intelligence, although he is backward in speaking, being at the age of 4 years unable to say more than a dozen words, though he appears to understand perfectly what is said to him.

Only one other similar case has come to my notice, that of an adult lady; no treatment had been adopted and the fixity of the head is complete. In this instance the intelligence and character are both above the average.

VII.

ON THE CURE OF THE CONGENITAL PSEUDOARTHROSIS OF THE TIBIA BY MEANS OF PERIOSTEAL TRANSPLANTATION.

DR. A. CODIVILLA, BOLOGNA.

The so-called congenital fracture of the tibia is frequently rebellious to any and every kind of treatment. A symptom that a cure is necessary is sometimes the angular deformity of a progressive nature which seriously impedes ambulation, in other cases there exists a real and very movable pseudoarthrosis which causes sharp pain on using the limb, and sometimes obliges the patient to use a crutch. These two conditions are only manifestations of two different degrees of the same lesion. The first often passes into the second after a tentative operation has been performed, as happened, for instance, in the case I intend to refer to. The lesion is purely local because the other parts of the skeleton are in a normal condition. The pathogenetic mechanism of the deformity is obscure. In many cases there exist symptoms of a former adherence of the affected part to the amniotic membrane. It seems that some mechanical cause may have disturbed the development of the part, and produced a permanent alteration of the tissues, rendering them deficient, or nullifying their osteoblastic power. In default of this powerful aid to the formation of a callus osseum it is not surprising that in the greater number of cases the usual methods of surgical assistance which are practised in correcting the common tibial deviations, and the cure of the acquired pseudoarthrosis should invariably lead to failure. If this does not happen in the rare cases when the osteogenetic property of the tissues is sufficiently maintained, the rule holds good that a relapse follows such operations, a relapse which frequently occurs after repeated and varied attempts made in a given case to obtain the disappearance of the mobility between the two tibial segments. This fact alone justifies me in communicating to the American Orthopedic Association the history of a case in which a recovery was obtained after a surgical operation quite different in itself from those commonly practised; an operation which seems to me based upon rational principles.

If we observe a radiograph of a congenital pseudoarthrosis, and for this purpose the radiograph of the case in question may serve, we are struck by the signs of atrophy which the tibia presents. In our case the tibia is almost one-third less thick than on the normal side, and the bone is notably transparent. The diminution of the tibia, and the transparency of the bone are more evident in the pseudoarthrotic region, and especially in the lower segment. The radiographic shade which this produces is much paler than that of the upper segment; starting from the epiphyseal region the bone rapidly takes a pointed form which terminates in a sort of knob lodged in the articular cavity of the upper segment. It is to be observed that in the vicinity of the pseudoarthrosis the lower segment loses all at once a great part of its thickness. We must admit that to account for the atrophied state of this portion of the tibia, the fault must be laid on the deficiency of osteoblastic power on the part of all the organs concerned in the formation and growth of the bone, but especially on the part of the periosteum to which the deficient thickness of the upper part of the lower tibial segment is certainly due. There is no solution of continuity in the fibula, but on a lower level than that of the tibia the bone is shrunk in a remarkable manner, taking the form of a spindle, whilst immediately afterwards it thickens to form the epiphyseal region. So, both in the tibia and perone, in a given region, signs of atrophy of the bone exist, with a remarkable diminution of thickness, due to a deficient forming function of the periosteum. In the extirpated pieces in the three cases under my care, the anatomical examination leads to the same conclusions.[1]

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[1] In the other two cases the operations did not lead to recovery. These consisted in the oblique resection of the affected part followed by metallic binding of the tibia in one case, and in the lowering of a periosteosteoplastic fold of the upper segment in the other.

The most rational operative means used until now for the cure of the congenital pseudoarthrosis have aimed at two principal results. 1. To clear away from the bony extremities which have been reunited by false articulation, the tissues which would have prevented the setting of the two parts of the tibia. 2. To set in the best position, the extremity of the tibial segment by means of metal ligatures, nails or ivory splints, splinters or ferrules of dead bone or with transplantations of splinters of living bone taken from the patient himself, or again with osteoperiostic folds formed by the two tibial segments. These means were used with the intention of providing for the new-bony formation by direct stimulation of the osteoblastic tissues produced by the foreign body placed between them, or by virtue of the intrinsic properties of the transplanted bone, or of the osteoblastic fold.

The results of these different methods were not successful. Even the operation of transplantation or bony plastics which gave such good results in the acquired pseudoarthrosis cases failed in the congenital. It seems that this fact confirms the conclusions to which Barth arrived in his researches on the bony transplantation.

It is proved by Barth's experiences that a transplanted bone cannot attach unaided, and is sure to die. It is only when it finds itself amongst tissues apt to produce bone, which supply it with the necessary inorganic materials, and serve as a woof to the new-bony formation, that it is not absorbed and eliminated, but little by little is substituted by living bone. This will happen very rarely in the congenital pseudoarthrosis cases, on account of the deficiency of the osteosplastic powers of the periosteum, and of the other organs requisite for the formation of bone. The same reasons may be adduced to account for the insufficiency of the osteoperiostic folds on the sides near the pseudoarthrosis.

Neither the conditions of the locality into which the fold is brought, nor those of the fold itself are favorable to a solid bone setting.

On account of repeated unsuccessful experiments of this kind, Reichel thought that the reunion could only be assured by the formation of a fold, in the Italian style, of periosteum, skin and bone; a fold taken from a perfectly healthy bone. In Reichel's case, in which neither a resection with metallic suture nor the transplantation of a splinter of bone from the healthy tibia succeeded, the fold in the Italian style supplied from the tibia on the healthy side attached perfectly well, and resulted in the recovery of the pseudoarthrosis. In executing this method of operation Reichel intended to transplant into the region of the pseudoarthrosis a splinter of normal living bone which would be capable of joining firmly to the edges, and so, following Barth's considerations, give a sure means of life to the bony transplantation.

Reichel's case proves that the transplantation in the Italian style of periosteum, skin and bone from one tibia to the other succeeds,[1] and can be made use of in rebellious pseudoarthrosis cases.

However, it seems to me that in the congenital pseudoarthrosis the aim can be obtained in a more perfect and rational manner by an operation in itself less serious, and easier for the patient to bear. The leading plan for the cure of the congenital pseudoarthrosis is not so much that of producing at once a rigid union of the two edges, and so taking away the mobility of the two tibial segments, as that of providing for the physiological deficiencies of the part affected, causing a renewal of the osteoblastic functions in this region. This seems possible by means of the periosteal transplantations.

From the studies of Ollier it is known how folds of periosteum detached completely from their nutritive sources, and transplanted far from their bed in the midst of tissues, live and maintain their osteoblastic functions. What Bath has said about bony transplantations does not serve for periosteal transplantations. These live their own life, and have no need to draw upon their surroundings for anything except the nutritious elements. The periosteal transplantations have been tried successfully in the cure of the bony cavity, and of bony defects and it has been seen that they live with great facility and form bone tissue. V. Mangoldt has used the transplantation of a periosteal fold in an osteomyelitical pseudoarthrosis.

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[1] In a case of defectiveness of the tibia through osteomyelitis I, too, have tried the transplantation in the Italian style of a thick piece, 10 cm. long, of the tibia on the other side, and have seen that the transplantation attached perfectly, even if, after a fortnight, the skin was completely taken away, to be returned to its normal place, which makes the consequences of the operation less serious for the healthy tibia.

In the case of the congenital pseudoarthrosis, it would not be difficult to substitute a deficient periosteum of the defective region with a normal one, and expect from it the cementing of the edges. Perhaps the process of reunion will be longer than by Reichel's method, but the result must be surer with regard to the future, because by the renewal of the periosteum the bone acquires a strong factor for its firmness. The operation is soon described.

Having extirpated from the affected region the soft tissues which are amongst the extremities of the bones, or better still, having removed the pseudoarthrosis in a lump, with two strokes of the chisel, or a saw, the periosteum is detached all round these bony extremities for a space of three or four centimeters. It is advisable that this tissue should maintain its nutritive connections with the soft tissues which surround it. In this manner the bed is prepared upon which the periosteal transplantations are placed. The periosteum which must serve for this purpose may be taken from the inner surface of the diaphysis of the healthy tibia. If the subject is still growing, it is better to make use of the periosteum which is found near the epiphyseal line as it possesses the highest forming powers. Having laid bare the tibial surface by a well directed incision of the skin, the limits of the primary periosteal fold are traced by four incisions of the periosteum. These must be of such dimensions, that when divided into six or eight rectangular strips, they can give the necessary amount of stuff to surround the two tibial edges completely, or cover them for two or three centimeters above and below their extremities. The limits of the primary periosteal fold being fixed, with a fine chisel one cuts from the whole extension of the fold a very thin layer of bone which remains attached to the periosteum, thus rendering it possible to preserve to the folds which are transplanted the lower stratum of the periosteum which is rich in osteoblastic efficacy. Having detached the fold with the scissors and divided it into the secondary aforesaid strips, these are placed one beside the other in the space left by the separation of the periosteum and other soft tissues from the extremities of the tibial edges. The strips with their bony surfaces are naturally turned towards the surface of the tibia, and are placed round it like the staves of a barrel. To keep them in their place one can resort to two sutures of silk or of silk worm, one above and the other below, which will fix the tibial edges together, or else simply with suture of the soft parts. It is also worthy of note that when the extremities of the edges are being prepared, the operator's chisel must shape them so that they have the same diameter and thus the transplantations can easily adapt themselves to each other. In the period which follows absolute and prolonged immobility is necessary. I will relate briefly the case on which I myself operated.

N. Levi, of Modena, 17 years old, was admitted into the Rizzoli Institute, presenting a pseudoarthrosis in the lower third of the right tibia. The two segments into which the leg was divided formed an open angle in the inside. The varus was to such a point that the foot rested upon the ground on the outside edge only. A remarkable mobility was noticeable in the pseudoarthrosis of the tibia. There did not seem to exist a solution of continuity in the fibula. Every movement of the foot, and every contact with the ground was so painful that the girl almost entirely gave up attempting to use the limb. The radiographs taken in the frontal and sagittal sense give an idea of the degree of deviation, and condition of the pseudoarthrosis. We have already spoken of the trophismus of the bone. The tibial deviation had been noticed from early infancy, the deformity, slight at first, had increased little by little until surgical assistance was necessary. The girl was operated on at 12 years of age, but I do not know with what method. There was a relapse with pseudoarthrosis, and a fresh operation at the Rizzoli Institute the 23. III. 05, which was performed on the lines above mentioned, viz.: A cutaneous incision on the outside of the leg on the lower third, exposing the fibula at the height of the pseudoarthrosis—oblique osteotomy. An incision on the inside disclosing the tibia at the seat of the deformity. Resection of the pseudoarthrosis. Isolation of the two tibial edges. Preparation on the other tibia of the primary periosteum fold, and division of the same into 8 secondary strips, 5 cm. long, and from 1 to 1½ cm. wide which are placed round the tibial edges. Deep and superficial sutures. Walling of all the leg, and half the thigh in plaster-of-Paris. The apparatus was taken away two months later, and we noticed that the correction of the deformity was good but that there still existed a notable mobility in the tibial edges. The patient was allowed to walk about for three months with her leg in plaster. When the apparatus was removed there was no longer a free movement between the edges, but on trying to produce one, the patient felt pain in the region of the pseudoarthrosis. The two segments of the leg had taken a slightly recurved position. Under narcosis the edges were put into their normal position again. The resistance which was felt during the straightening process shows the progress made in the work of reparation of the periosteal transplantation. The immobility under plaster was continued till February 26, 1906, then the leg was let free, and subjected to massage, and prudent attempts at walking. Neither movements nor pain were felt in the operated region.

The patient soon succeeded in walking without any assistance and quite easily. A high boot, which also supports the lower half of the leg, makes up for the 7 cm. shortening of the right leg.

Radiographs, taken at different times after the operation, show the progressive work of the periosteal transplantation. The tibial edges which are not joined are seen slowly disappearing under an ever increasing thickness of peripheric bony tissues. It is also possible that in the course of time the newly formed bone may end in substituting or cementing the tibial extremities so completely that no radiographic sign will remain of the former disunion. But even if this does not happen the wide ring of compact bone which the periosteum has formed round the weak point of the tibia is more than sufficient to reassure us of the solidity of the tibia. The radiagraphs show, however, that the two edges have not behaved in the same manner in regard to the transplantation. The upper edge has easily become fixed to the bone formed by the periosteal transplantation, the lower edge on the contrary has shown less disposition to this reunion. This agrees with what was remarked before operation about the atrophy and the conic form of the lower edge, and confirms the opinion that the pseudoarthrosis was due to the want of osteoblastic power, especially on the part of this segment. This fact, proved by the radiographs, confirms the difficulty of the case.

The following considerations heighten the value of the method:

The operation was performed upon a girl who had finished growing, so that the periosteum no longer possessed the productive vitality of youth; a girl who was tall and stout, and whose weight put to the utmost proof the limb which had been operated upon.

PERCIVAL POTT, ESQ'R.
Engraved by Heath after Sir Joshua Reynolds, 1790.

VIII.

WAS PERCIVAL POTT REALLY ENTITLED TO THE HONOR OF HAVING A CERTAIN SPINAL DISEASE CALLED BY HIS NAME?

A. J. STEELE, M. D.

I have never been partial to the application of proper names to the diseases of the human body, or to its anatomical peculiarities. We have not a few instances of the latter, as Achilles, Silvius, Rolando, Steno, etc., of the former as Bright, Renard, Addison, Strumpell, etc.; and even in our own department, Dupuytren, Charcot, Still, etc., but most of all Pott; a name doubtless on the lips of the profession more than any other.

These proper names carry with them an idea of honor to which the individual was entitled by virtue of discovery or first accurate description, and in that light seem reasonable. But a name should, so far as possible, carry with it a description of the thing itself, or some peculiarity, or indicate its office or its function or its pathology. The profession are agreed to this, and are beginning to drop the proper names. Thus, we now rarely hear of "Bright's disease," and in lieu of "Pott's disease" we prefer to say tuberculous spondylitis, which interpreted means an inflammation of the spine, tuberculous in character. It carries with it the pathological condition of the affection; it has a definite significance; but the old name is too familiar, too brief, too terse to readily admit of change, so it will remain. But the query arises, did Percival Pott really deserve, for any work he had done, the worldwide honor that has already for one and one-quarter centuries been awarded him? This recognition of his worth and work turned upon the facts contained in an illustrated brochure he gave to the profession in 1782, describing a spinal trouble till then little understood. Judging from the title, it was written to clear up one sign, or, as we now term it, complication of the disease which has taken his name. The title of the work, which I have, is: "The Useless State of the Lower Limbs in Consequence of a Curvature of the Spine." Several charming illustrations elucidate the text.[1] The title is misleading, for later on he asserts that the cause of the useless limbs is a distemper which produces a destruction, or caries, of the vertebral bodies. Pott was the first one to assert that the curvature and the palsied limbs were due to one and the same cause.

Mr. Pott wrote two articles on this subject. In the first one he designated this condition of the lower limbs as a "palsy," but three years later he dropped it for the term "useless state," etc., preferring to limit the term palsy to what we designate flaccid paralysis. The element of spasticity staggered him.

In that day it was generally supposed that the deformity, or

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[1] We have borrowed a few of these illustrations because of their excellency, and to prove that our author well understood the macroscopic appearances and the changes that took place in the bones.

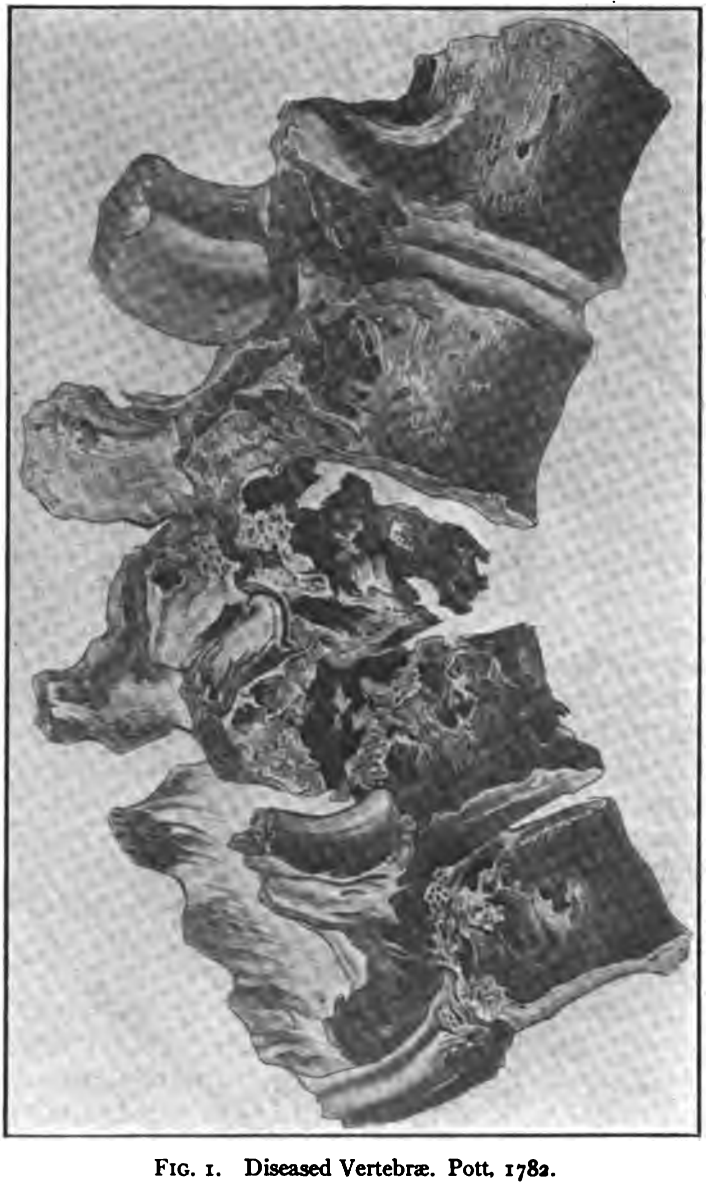

FIG. 1. Diseased Vertebræ. Pott, 1782.

curvature, of the spine was due to a dislocation of the vertebræ, and the palsy to pressure on the cord by the displaced bone. All this Pott denied, making the following assertions: That the disease producing the spinal trouble was scrofula, now known to be tuberculosis; that the marks of ill-health supposed by everybody to be the result of the distortion were due to a systemic distemper, which also was the cause of the spinal breakdown; that erosion of the bodies of the vertebræ, and not enlargement, was the result of this distemper; that the bodies of the vertebræ above and below the eroded ones were brought nearer each other, causing the posterior projection; that when located in the dorsal vertebræ, the sternum and ribs became deformed; that it was the vertebral bodies, never the articular processes, which were diseased; that without such erosion there could be no deformity; that disease of the upper spine was more apt to be followed by useless state of the lower limbs than of the lower spine; that "lumbal" and psoas abscesses were so called because of the place or region where they made their appearance externally; that caries of the spine was the cause of these abscesses; that the generally received opinion that all the attending symptoms were derived from the curvature, considered abstractly, was by no means founded on truth; that curvature with useless lower limbs was not due to a dislocation; that a distempered state of the parts preceded the erosion and was the original cause of the caries, the curvature and all the attendant mischiefs; that the attempts to reduce the supposed dislocation by means of swings, screws, etc., could possibly do no good, but on the contrary harm; that general complaints would be found to have preceded the curvature.

All these conclusions of Pott were at the time new and original, and all credit is due him. Thus the honor conferred by using his name in connection with this "distemper" is just. It was well earned. In the matter of his treatment of the "distemper" causing the palsy, we cannot be so commendatory. He advised issues which encouraged suppuration. Cures were reported, but not, I believe, as a result of the counter-irritation, but because of the perforced quiet and rest given the spine from the paralysis and from the soreness induced by issues. This idea of treatment by suppurative counter-irritation continued for many years thereafter, for at the time of my graduation I saw Gross and Pancoast use the actual cautery on children's backs suffering from tuberculous spondylitis. The odor and smoke of burning flesh were

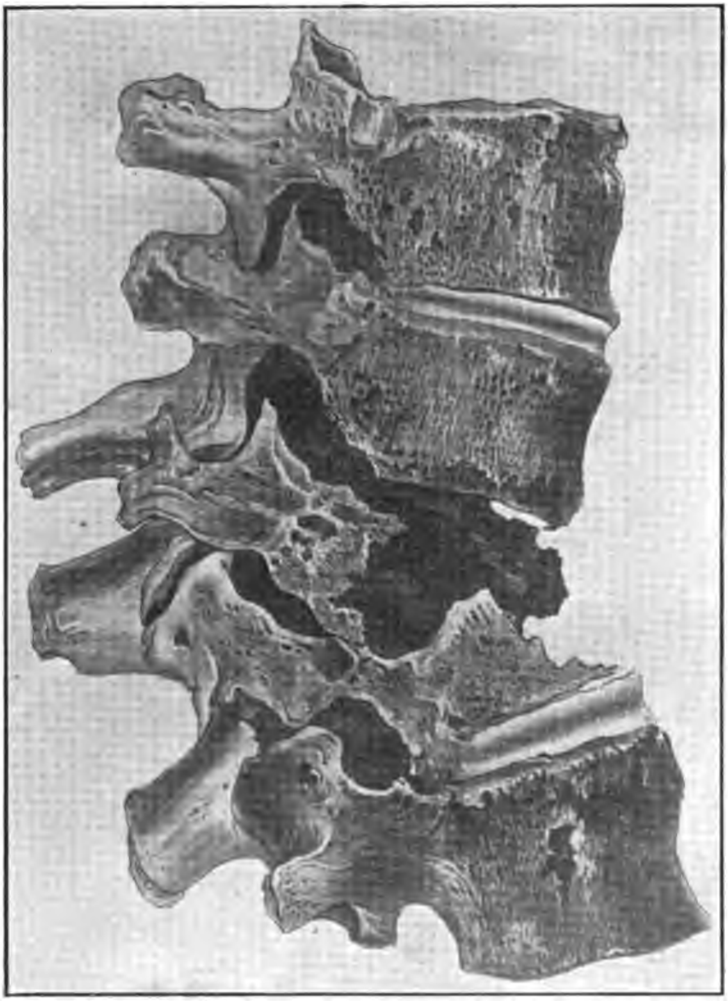

FIG. 2. Diseased Vertebræ. Pott, 1782

marked. Today, the pathology being better understood, the therapeutics are more rational.

Was Pott, as an educated man and as a well informed, efficient and progressive surgeon, entitled to the consideration and honor of the profession? We believe so; and that he is to be admired, a few facts culled from his life will be convincing. Born in London in 1713, where now stands the Bank of England; his father died when he was four years old, leaving him a patrimony of five pounds sterling. This amount was found after Percival's death among his effects in a tin box, the son having religiously kept it all his life—inviolate. When sixteen years old he was bound for seven years to Ed. Nourse, Surgeon to St. Bartholomew's Hospital, for which his mother paid two hundred pounds, as a premium. Young Pott was privileged to prepare the subjects for demonstration which his preceptor used in his anatomical lectures. At the age of 23 he was admitted to the freedom of the Barbers Co. Three years later he took the livery of the Barber-Surgeons Co., paying ten pounds for the same. When the Barber-Surgeons Co. was dissolved, Pott allied himself with the Surgeons. In 1753 Pott and John Hunter were elected the first lecturers on anatomy of the Surgeons Co. At the age of 48 he was elected examiner, and when 52 governor of the Corporation of Surgeons. He had been made Assistant Surgeon to St. Bartholomew's when he was 31 and full Surgeon five years later.

Pott introduced many improvements into the art of Surgery during his long term of office, rendering its practice more humane and less painful both to patient and surgeon. Escharotic dressings were constantly employed, and the actual cautery was in such frequent use that at the time of the surgeons' visits at the hospital it was regularly heated and prepared as a part of the necessary apparatus. It was only by Pott's constant endeavors that these abominable methods were discarded.

When he was 43 years old, he was accidentally thrown from his horse, producing a compound fracture of the leg, the bone being forced through the integument. He would not suffer himself to be moved until he had made the necessary dispositions. He sent to Westminister for two chairmen to bring their poles, and patiently lay on the cold pavement—middle of January—until they arrived. He purchased a door, to which he had them nail the poles. When all was ready, he caused himself to be laid on it and carried home. The consulting surgeons considered the case so desperate as to demand immediate amputation. Pott, convinced that no one could be a proper judge of his own case, submitted to their opinion, and the instruments were actually gotten ready, when Mr. Nourse, his former master, who had been prevented from coming sooner, entered the room. After examining the limb he conceived that there was a possibility of saving it. This opinion

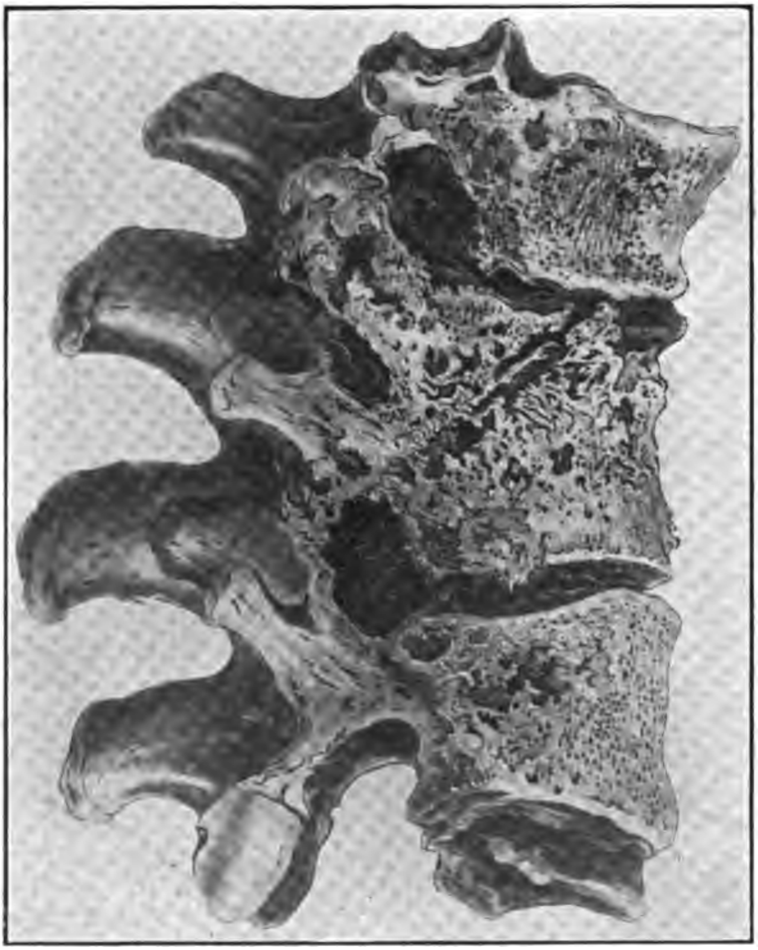

FIG. 3. Cured Vertebræ. Pott, 1782.

was acquiesced in, the attempt was made and fortunately proved successful. The term Pott's Fracture is still commonly applied to that particular variety of broken ankle which he sustained on that occasion.

During the necessary leisure attending his confinement, Pott first turned to authorship, planning a treatise on ruptures. He thus began to write at the age of 43, exactly when his illustrious pupil, John Hunter, published his first book. From that time on he published a long series of books, and his writings revolutionized the practice of surgery in England. His lectures at St. Bartholomew's became the most celebrated in London. At the age of 51 he was elected a member of the Royal Society. In 1783 he treated Dr. Johnson for sarcocele. In 1786 he was elected an honorary member of both the R. C. S., Edinboro, and the R. C. S., Ireland. At the age of 74 he resigned the surgeoncy of St. Bartholomew's Hospital, having served it half a century, and was elected a governor, but lived to enjoy the honor only one year, dying of pneumonia in 1788. John Hunter was elected to fill his place in the Surgeons Co. in the following year.

While his mother lived, he was her comfort and stay, having remained single until after her death, then he married and nine children blessed the union. His kindness of heart was proverbial. At one time he had three needy surgeons living in his house until he could provide them with the means of earning an independent livelihood. His high character and blameless life helped to raise the social standing of the surgeons in England.

Early in life he predominated in a profession which has been said not to procure its members bread until they have no teeth to eat it. (Wadd.) He was the first surgeon of his day, and as a scientific writer, remarkable for the classic purity of his style, the scrupulous precision of his definitions and the unerring closeness of his argument. He introduced in surgery a wholesome skepticism. In practice he relied on his own observation, and was guided by common sense. He was a clinical rather than a scientific surgeon, for pathology as yet had no existence. In practical surgery, he takes rank before his pupil Hunter; but in scientific surgery the pupil was greater than his master. He has no work on General Surgery, but many tracts on special subjects, which have been edited and bound in three volumes, on every page of which I find interesting reading.

He surely was so good a man and so great a surgeon that no discredit will be done if we continue to apply his name to the tuberculous spine.

Note.—Many of the above facts were culled from Pott's own writings as well as from those of D'Arcy Power, F. R. C. S.

IX.

DOUBLE CONGENITAL EQUINO-VARUS IN TWINS.

J. TORRANCE RUGH, M. D.

Assistant Orthopedic Surgeon to the Jefferson Hospital; Orthopedic Surgeon to the Methodist Episcopal Hospital; Assistant Orthopedist to the Philadelphia Hospital, etc.

In April, 1903, Walter and Edgar R., twin boys, aged three years, were brought to the Orthopedic Dispensary of the Jefferson Medical College Hospital for the correction of double congenital equino-varus. They were the youngest of a family of seven children and the other five were well formed, normal, healthy and each one a single birth. The father was a farmer and both he and the mother were free from any deformity and always enjoyed good health. There was no family history of deformity of any description and the parents could give no explanation of the occurrence of the malformation. The boys were both sturdy and healthy and presented no other condition than the double club-feet of the second degree. Nothing had been done toward the correction of the deformity and they had been walking about upon the outer and dorsal aspects of the feet for two years. Careful examination of the feet led to the conclusion that before resorting to operative measures, it would be advantageous to secure as much correction of the varus as possible by means of plaster-of-Paris carefully applied. This was accordingly done, the casts being renewed every six weeks because the patients lived quite a distance up the state. At the end of four months, operation was decided upon. Under an anesthetic, subcutaneous section of the plantar fascia and of the anterior and posterior tibial tendons was done and the varus overcome. The tendo Achillis was then divided and the feet entirely overcorrected. Plaster was again applied for a period of six weeks after which shoes with braces to maintain correction were adjusted. The immediate results of the operation were excellent, the children being able to place the soles of the feet firmly upon the ground. The probability of a relapse of the deformity is very great inasmuch as they are so far removed from our personal care and supervision, their own physician in the country not being familiar with the after-treatment of such cases and they too poor to travel back and forth.

From time immemorial, the greatest interest has centered in the etiology of congenital deformities. Many theories have been constructed at various times and almost as many have been discarded as untenable. The almost insurmountable difficulty of ascertaining the factors which have separately or collectively determined the deformity is recognized by all and any experience or observation which may shed the slightest light upon the subject is of professional interest and scientific value. Out of the great mass of conjectural publications and investigative work, there remain but four or five theories which are accepted by the medical profession as probably truly explanatory of the etiology of these conditions, especially club-foot.

Heredity is a readily demonstrable factor in the causation of these deformities and many interesting reports of their transmission through several generations have been published from time to time. In other instances, however, a congenitally deformed parent has begotten normal children or has transmitted the malformation to but one member of the family while the numerous other members have been entirely normal. Such instances furnish material and scope for no end of theorizing but after all has been said, no more is known than what has been observed.

Probably the theory of intrauterine pressure or the mechanical theory has had more advocates than any other because it is the oldest, and certain cases lend much confirmation to it. The observation of many obstetricians, however, is that polyhydramnios is a very common accompaniment of the distorted and deformed fetus, especially if there are multiple deformities. This would suggest that the causative factor lay within the fetus itself rather than without it. There is no doubt, however, according to numerous observers, that mechanical interference does exist in certain cases to the extent of causing the maintenance of a certain posture which in due time becomes a deformity.

The nervous theory, based chiefly upon the general experience that the most frequent cause of acquired club-foot is infantile paralysis, has received quite extensive support. No pathological evidence has, however, been presented to prove the theory. All symptoms of muscle or motor paralysis have disappeared ere the time of birth or of the examination of the case and naught exists beyond the muscle atrophy and shortening. This fact, of course, does not disprove the theory, inasmuch as many cases of anterior poliomyelitis recover entirely and if they do so post-natal, why not ante-natal when the reparative processes are so much more active.

The theory of arrest of development is a very popular one but its vagueness as to the cause of the arrest is its most unsatisfactory feature. If the malcondition has been due to the interference with the nerve supply, blood supply, cell activity on the part of the bony or other structures, all traces of organic causes have been removed ere the examinations have been made as nothing demonstrable has as yet been found. It is one of those theories which explains in terms of itself, describing the condition as found without supplying the etiological factors.

Retarded or inhibited rotation of the feet and legs is one of the most recently advanced and investigated theories. It is certainly more scientific than the others and, as elaborated by Eschricht, Berg and others, furnishes credible proof for the greater number of cases. The failure of the limbs to rotate may depend upon a variety of causes, chief among which are, the mechanical disparagement between the size of the fetus and the uterus, amniotic bands, tumors, etc. Another cause is that during gestation and in the development of the fetus, certain changes of position take place in logical sequence, as for instance, the change from the upright to the inverted posture, but in individual cases these changes are neglected and the position, which at a certain stage of the development was normal, becomes abnormal, and maldevelopment results.

In looking over the statistics of various writers on the etiology of club-foot, I find a great scarcity of detail as to the relative frequency of its occurrence in twins. Chaussieur found 37 club-feet in 23,923 births, giving a proportion of 1 in 646, while Lannelongue published statistics showing the proportion to be 1 in 1,903 cases. The combination of these two reports gives the ratio of one case in every 1,275 births.

Veit, in examining the record of 13,000,000 births, found the frequency of twins to be 1 in 89. Other statisticians give the ratio as 1 in 100 so there is rather close argeement in the matter. Taking the proportion at 1 in 90, there should be in the 1,275 births, 14 cases of twins and among these, if the same ratio exists, there should be found one case of club-foot. Bradford and Lovett report 488 cases of club-foot treated in the out-patient department of the Children's Hospital, Boston, which according to the above proportion would represent the number occurring in 622,200 births. Taking then Veit's statistics, there should be among this number 6,913 cases of twins but Bradford and Lovett have not instanced the occurrence of one case in plural births.

Martin (F.) records having seen many cases of club-foot in twins, considering it, in fact, a common accompaniment of plural births because he found there had been no greater quantity of liquor amnii in such cases than in single births. He is quoted by numerous authors to the effect that twin pregnancies are a factor in the causation of club-foot but the only specific instance reported by American writers is that of Roberts (Memoirs of A. Sidney Roberts by J. K. Young, p. 32) in which one child had double equino-varus and the other was normal. Parker quotes Martin extensively and also mentions having seen two or three cases of club-foot in one member of twins while the other was undeformed. He also inclines strongly to the support of the mechanical theory as a cause. Hoffa, in his latest work, mentions multiple pregnancies as an etiologic factor but cites no specific instances of his own observation. Young mentions Roberts' case while Whitman, Walsham and Hughes, Tubby, McCurdy, Bradford and Lovett, Moore, Sayre, and Ketch do not mention the condition.

A year or so ago, I instituted a search for cases of this kind and sent requests to most of the members of this Association and received replies from twenty men and but one could recall having seen any instances. Dr. J. K. Young reported having seen one case which has been mentioned above. Inquiry was then made of the leading obstetricians of Philadelphia and the records of three of the largest maternity hospitals of the city were examined for the following information:

Number of cases of twins..........................
One child had one foot deformed in................cases.
Each child had one foot deformed in..............cases.
One child had both feet deformed in..............cases.
Each child had both feet deformed in............cases.
There was polyhydramnios in.....................cases
There was lessened amount of liq. amnii in........cases.
There was normal amount of liq. amnii in..........cases.
There was evidence of amniotic bands or adhesions in...cases.

The replies were uniformly negative so far as concerned the presence of deformities in the cases of twins. Polyhydramnios was almost uniformly present and where it was absent, the quantity of liquor amnii was normal. This observation is at variance with that of Martin who seems to have noted the greatest number of this class of cases, but a comparison from this standpoint is impossible, since in his experience with the lessened amount of fluid, there would be greater pressure upon the fetus. The modern experience appears to contradict his conclusions both as to the frequency of the occurrence of club-feet in plural pregnancies and as to the matter of intrauterine pressure, due to a supposed disparagement between the size of the uterine cavity and the fetus. The presence of amniotic bands, adhesions, tumors, etc., are decided factors in some cases of congenital malformations through the pressure exerted, but the importance of twin pregnancies as a factor in the production of congenital deformities of the feet is entirely negatived by the rarity of this class of cases.

X.

DEFECT OF BOTH FEMORAL HEADS IN A CHONDRODYSTROPHIC DWARF.

ALBERT H. FREIBERG, M.D., CINCINNATI, O.

The opportunity to examine the patient, C. C., was afforded me for the reason that she was thought to have congenital luxation of the hips; this was because of the peculiar waddling gait with which she had walked from the beginning. The notes made at the time of the examination are as follows:

She is 15 years of age. She is the first child of her mother and was born after a normal pregnancy and labor, weighing 8½ pounds at birth. The mother who was present at the examination was to all appearances a perfectly normal person. There was nothing worthy of remark in her personal history.

At the birth of the patient it was at once remarked that she was very short for a full term child. Her infancy was, with this exception, perfectly normal; she was breast fed and walked at sixteen months. The waddle which was at once observed has persisted. The mother thinks that it has grown worse.

Menstruation was established at the age of thirteen but has always been irregular. She is mentally bright and has always held a good place in her class at school. She has never been able to walk as far or as long as her playmates; she tires easily and frequently suffers pain in the thighs and hips upon carrying the effort too far.

The patient is obviously undersized. She measured 48 inches without shoes. Examined nude, the trunk appears disproportionately long for the arms and legs. The shape of the head is very square and it seems very large. No measurement was taken. The nose is depressed at the bridge but very broad below. The mother says it resembles neither hers nor that of the father. The chest is of good shape and there is no trace of beading of the ribs. The long bones seem fairly straight. The shafts of the humeri and femora seem unusually thick but present no unevenness.

The gait of the patient strikes one at first as very similar to that of bilateral luxation of the hips. It is, however, soon apparent that the similarity is far from exact; there is not the typical swaying of the pelvis, and while the abdomen is prominent the lordosis is slight. Trendelenburg's sign is not present.

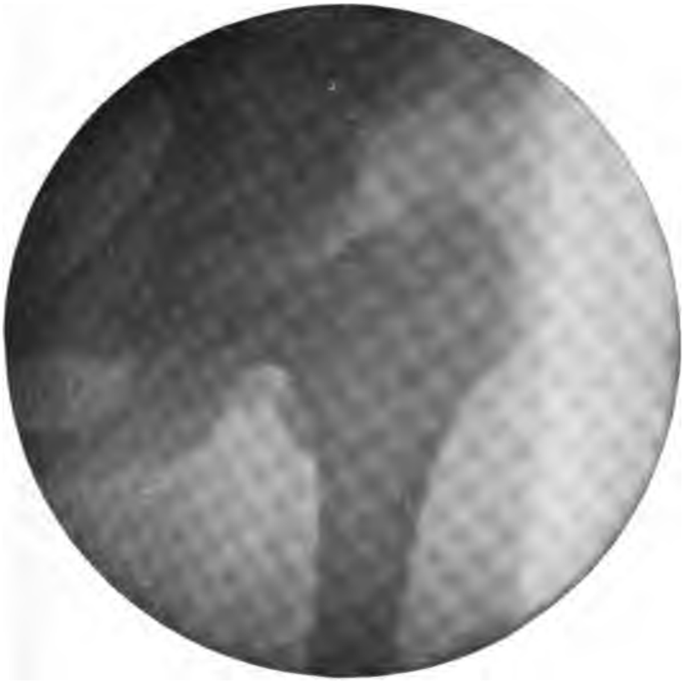

FIG. 1.

Examination of the hips shows great limitation of abduction and internal rotation. Adduction, flexion and rotation outward are normal while there is limitation of extension amounting to a few degrees. The provisional diagnosis of congenital coxa vara was made and radiographs were taken, the appearances of which are described below.

It was arranged that the patient should return for a complete series of measurements and also for photographs of the figure and it is a source of great disappointment that she failed to do so.

X-ray Appearances.—The radiograms upon which the following description is based were made with an experimental diaphragm apparatus and for this reason leave much to be desired in the way of clearness. It is my hope, nevertheless, that this report may be acceptable because of the rarity of the condition and the interest which attaches to it.

The radiograms of the two hips are so very similar that I shall content myself with describing the right one. It strikes one at once that the femoral head is absent in its entirety. The trochanters are approximately normal in shape and reciprocal relations. The shaft of the femur is very slender for that of a girl of fifteen; the bone seems of normal density. The feature of the radiograms which is at once noted is the absence of the femoral head. From the intertrochanteric ridge upward, the neck has its beginning in an apparently normal manner; it very soon terminates abruptly, however, in an oblique, rough and irregular surface, which appears to furnish the articulating area for the acetabulum in lieu of the femoral head. Above the trochanter minor, the portion of the femoral neck which is here seen is bent downwards, in the sense of coxa vara. This portion of the neck makes an angle with the shaft of about 77 degrees. The articulating surface makes an angle of about 60 degrees with the axis of the shaft on the right side and about 45 degrees on the left. The acetabulum of both sides has a shape to correspond with that of the surface on the end of the neck which articulates with it. The surface of the interior appears to be smooth. Examined on a large plate showing both hips and the pelvis the latter presents a decidedly normal shape. The obturator foramen appears flattened from above downwards, the ascending ramus of the ischium much shortened.

The wings of the ilia are small and the general contour of the pelvis as well as its cavity seem shortened in their vertical diameters and of square shape.

Careful scrutiny of the radiograms has made me believe that the rough surface of articulation on the rudimentary femoral neck represents the site of the epiphyseal line and that we are, therefore, dealing with an arrest of development of the capital epiphysis of the femur.

In considering the nature of the case just described and particularly of the deformity of the hips, the first question of importance is naturally that of the underlying pathological process. Is this a case of Chondrodystrophia fœtalis? I believe that, although my examination was unfortunately not as complete as I intended it should be, there can be little doubt of this. The statement of the parents, who are themselves above average height, that a disproportion between the length of the extremities and of the trunk was noticed at the child's birth, is to me important evidence. The child was certainly not a cretin nor could evidence of rickets be found in the history or by the examination, save the one element of dwarfism. Granted that the case is one of chondrodystrophy, it seems to me that this must be held as standing in an etiological relation to the deformity of the hips.

After a fairly complete examination of the literature of chondrodystrophy and the allied conditions, I have been unable to find mention of a case in which there was complete absence of an epiphysis. It is not the purpose of this paper to discuss the pathology of chondrodystrophy in general. It seems pardonable, however, to point out that Kaufmann's classification, which has obtained general acceptance, recognizes three varieties of the disease. These are: 1st, an hypoplastic form, 2d, an hyperplastic form, 3d, a malacic form. *With the last two forms mentioned, our case can certainly have but little in common.* The first form, however, corresponds in its general characteristics to the condition in the hips of this patient. It must be borne in mind, in this connection, that while there is no trace of the capital epiphyses to be seen in the radiograms, it is possible that cartilaginous vestiges of both of them are present. In this case we should be justified in speaking of hypoplasia rather than aplasia. The condition of aplasia in the epiphysis has not been described as a part of the chondrodystrophic process. Indeed, it is for this reason that objection was made to Parrot's original name, achondroplasia. It is significant that in this case the epiphyseal line seems to mark sharply the limit of whatever pathological process there was. This corresponds fairly well with the theory of periosteal inclusion, microscopic evidence of which has been furnished for quite a number of cases.

It is interesting to note that this case bore sufficient resemblance to congenital luxation clinically to have been mistaken for that condition by another practitioner. While this resemblance did not stand the test of careful clinical examination, it was, nevertheless, by no means an unpardonable error. The gait of the patient was very similar to that of luxation patients.

Kassowitz has laid stress upon the fact that congenital luxation has been observed in several chondrodystrophic patients and is inclined to attribute much importance to this coincidence, pointing out that Grawitz had shown microscopically a disturbance in the ossification columns of the epiphyses which combine to form the acetabulum. An examination of the work of Kaufmann with reference to the case at present under discussion, would appear to show that the abnormality in the femur is the principal one in the chondrodystrophic process, the acetabulum being abnormal to a far less degree. This hardly corresponds to the radiographic and pathological evidence in our possession concerning congenital dislocation of the hip, since the deformity of the acetabulum is practically always greater than that of the femur, the latter being regarded as adaptive rather than as primary. This view is strengthened by the fact that in a number of cases of unilateral luxations, Hoffa was able to demonstrate evident abnormalities in the acetabulum of the clinically normal side by the X-ray demonstration. It must be said, therefore, that up to the present time no definite association between chondrodystrophy and congenital luxation of the hip has been shown. A certain analogy might appear, however, between the cases of congenital coxa vara which have been lately described as having their origin primarily in defective development of the upper end of the femur, such cases having been described by Feiss, Reiner and Drehmann.

However, there has been no evidence brought forward of the existence of the chondrodystrophic process in these patients, their other bones having been found normal. It is to my mind unlikely that any pathological connection exists between them. The cases of femoral defect which I have had the opportunity of observing have been in otherwise perfectly normal children.

The fact that there is a connection between the chondrodystrophic process and the deformity of the hip in this case is strengthened by the examination of Kaufmann's monograph, in which there is represented the femur of an infant whose bones he was able to examine and which presented a capital epiphysis so rudimentary as to place it in the same category with the case under discussion. I look upon my case, therefore, as one of arrested development of the head of the femur caused, in all probability, by the ingrowth of the periosteum at the epiphyseal line.

I shall not discuss the difference between chondrodystrophy and rickets, strong reasons having been brought for the abandonment of the term fetal rickets for most of those cases previously so designated. However, it appears to me that this case is an additional evidence for the separate identity of chondrodystrophy and rickets, since no process of this kind has ever been seen in connection with undoubted rickets.

In conclusion, it must be acknowledged that the practical importance of this case is not great, save in a diagnostic sense. I believe it instructive since the case was considered congenital luxation by an able practitioner and since I looked upon it at first simply as one of congenital coxa vara. I think it will be apparent that the true nature of the deformity could be recognized only by radiography and it therefore emphasizes the necessity of careful examination, by this method, of all cases of this character.

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XI.

A SIMPLE METHOD OF CORRECTING PIGEON-TOE OR INWARD ROTATION OF THE THIGHS.[1]

R. TUNSTALL TAYLER, M. D., BALTIMORE.

Pigeon-toe may be defined as that condition which exists when the internal margins of the feet tend to converge and make an angle anterior to the plane of the body, instead of the internal margins being parallel or diverging anteriorly, as is normal.

This toeing-in is due to the excessive action of the internal rotators of the thighs or the deficient action of the external rotators from habit, weakness or paralysis.

We recognize the internal margin of the normal foot as approximately a straight line and when we have a toeing-in, in such a condition as talipes varus, we have not a pigeon-toe necessarily in its true sense, for when we restore the normal angle of deflection of the foot in this deformity, the toeing-in will disappear, provided the os calcis is in its normal relation to the line of progression.

Occasionally we see cases of double talipes equino-varus, in which we have entirely corrected the varus and equinus elements, but in which the child still walks pigeon-toed; this can only be explained by an abnormal action of the rotators of the thighs, and a correction of this abnormality will correct the deformity.

If one reviews the anatomical relations of the muscles of the thighs and their actions, one will find thirteen outward rotators of the thigh and only three inward rotators.

The outward rotators are the three glutei, the two obturators, the two gemelli, the pyriformis, the quadratus femoris, the three adductors and the sartorius.

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[1] Read by title before the American Orthopedic Association at Toronto, Canada, August 21, 1906.

The inward rotators are the tensor vaginæ femoris, the gracilis and the semitendinosus.

For the purpose of correcting pigeon-toe, I endeavored to simulate the action of the sartorius.

In a paper before this Association, Gibney (American Journal of Orthopedic Surgery, Vol. ii, No. 1) first called attention to the contraction of the tensor vaginæ femoris, as the causative factor in producing pigeon-toe in some cases of spastic paralysis and by its division this deformity could be corrected.

In the ordinary type from habit or weakness no contraction of the tensor vaginæ femoris can be made out, but it is due to *weakness* and *underactivity of the outward rotators*, hence any myotomy of the tensor vaginæ femoris would not be indicated and would accomplish nothing.

The device herewith presented is very simple and effective.

It consists of a snug fitting muslin pelvic band lacing in front, and on each side about one or two inches below and posterior to the situation of the anterior superior spines of the ilia are sewed buckles obliquely. This band is to be pinned with safety pins to the under skirt.

Two strips of surgeons' adhesive plaster, one and a half inches wide and from four to six inches long, have a piece of felt one and a half inches square and a buckle sewed on one end of each. These adhesives are then stuck on the back of the calf of each leg in a spiral manner so that the buckle and felt come to lie on the posterior inferior aspect of each internal condyle of the femora.

The apparatus is completed by means of a piece of non-elastic webbing which is fastened in the two buckles on each leg following the direction of the sartorius and buckled sufficiently tight to effect the desired amount of outward rotation, preferably when the child is recumbent.

This device is much less annoying than any form of steel brace and naturally much tighter. It is more effective than any method of raising the sole of the shoe or having straps from the outer sides of the shoes.

It is simply designed to effect a functional use of the limbs in a less unsightly manner than the patient has been accustomed to and can be regulated to a nicety, if it is proved in a relaxed child that too much eversion would tend to pronation and a valgus condition.

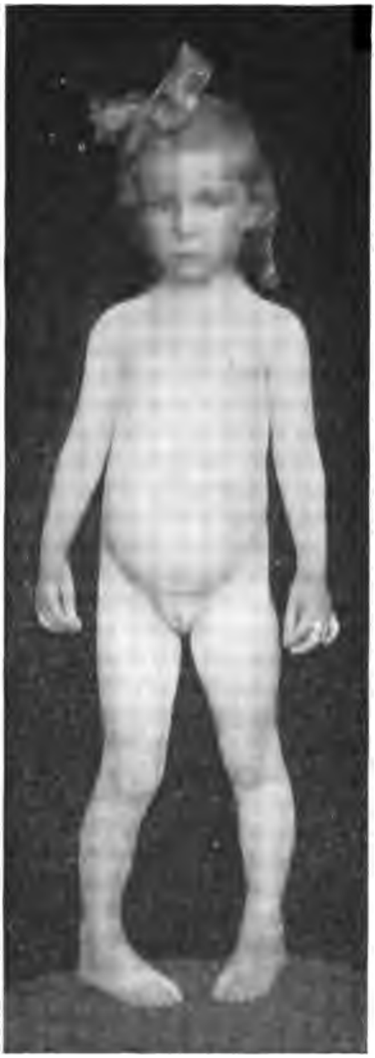

FIG. 1.

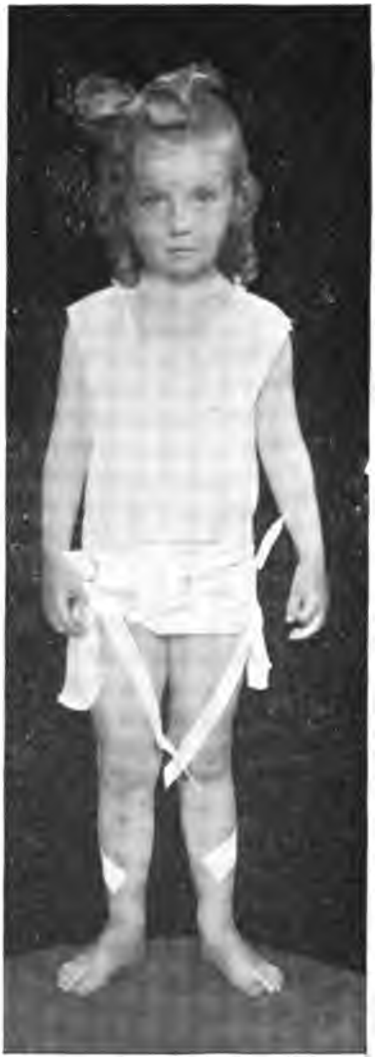

FIG. 2.

While wearing and for a time after discarding this appliance, the patient should have daily massage and slowly interrupted faradic electricity to the gluteal region and the adductors as well as such Swedish gymnastics, as will increase the power of the outward rotators. Standing on each leg alternately and swinging the trunk and other leg posteriorly and to the other side, as in skating, the "outer edge" backward; lying, outward rotation of the thighs, legs straight, with resistance; lying, alternate leg adduction with outer edge of the foot to floor, etc., will be found useful.

XII.

A SIMPLE METHOD OF RECORDING THE TORSION IN LATERAL CURVATURE.

E. H. BRADFORD, M. D.

The number of methods of recording scoliosis is itself a proof of the complexity of the problem, and also of the fact that no method as yet in use gives thorough satisfaction. Photographs can be made sufficiently precise to record spinal curves, deviations in outline and distortion of attitude, but it is difficult by photograph to reproduce the amount of torsion and structural changes with sufficient accuracy for the purposes of satisfactory clinical work. Lead tracings are open to the criticism of inaccuracy, as it is impossible to apply strips of lead around the thorax without a certain amount of manual pressure by the recorder which in itself is liable to error unless the lead strips are so pliable as to adapt themselves on slight pressure. Where this is the case the lead cannot be transferred to paper in marking the record without a danger of change in shape.

The hat measuring type of recording apparatus is so expensive as to prevent its general adoption and the pantogram records are complicated and are not accurate. The following method is suggested as inexpensive, simple and recording torsion satisfactorily. It consists of the application of softened strips of dental wax cut in bands one inch in width and a quarter of an inch in thickness. These bands are made from the quick hardening dental wax which is softened under warm and not hot water and rolled out into a plate of any desired length and thickness. While this is soft the wax is laid upon a flat table and cut into strips of the desired length and width. When the strip is still soft it can be curved and placed into a flat pan until used, with the cut edge down. It is evident that the bands should be cut true so that the edges are parallel. When the record is taken the patient is placed upon a board or hard, flat lounge lying face down, at ease and with relaxed muscles, with the arms and thighs placed in such a position as may be comfortable for the patient, with the face turned to the side. By means of a skin pencil marks are made upon the back at the points where it is desired that records of a cross tracing of the trunk be made. The strips of dental wax are then placed in water of sufficient warmth to soften them thoroughly and then laid upon the marked portion of the back, care being taken that they should be laid accurately and not diagonally. The wax should be of a consistency to mould itself readily when laid upon the patient's back without the need of localized pressure. These wax bands can be laid at any desired level and a number of cross tracings taken at the same time, while the patient is at rest until these strips are hardened. The amount of time necessary for this varies with different preparations of dental wax, but a few moments only are needed with the quick hardening wax.

After the wax has become hard it can be removed from the patient's back. If the wax is placed around towards the front of the chest it can be cut or broken at the sides in order to remove it, giving a record of the back half of the thorax, or it may be cut in the middle and the two halves removed recording three quarters of the thorax. The accuracy of the application of the wax can easily be tried and if defective the wax can be softened and re-applied.

This process is not a fatiguing one to the recorder or to the patient and no difficulty is met in the restless change of position on the part of the patient, nor is great care needed when the wax is removed from the patient and placed upon paper for a pencil tracing. It is, of course, necessary that the tracings should bear relation both in deviation and rotation to that presented by the patient's back. In order that this be done, while the patient is recumbent, the middle line is marked upon the wax strips and the spinous processes as well, and the distance of two marked points on the wax strip should be measured from a rod laid along the middle line of the back, in this way triangulating the relation of the wax from a middle point. The wax should be laid upon the paper at the requisite distance from the point indicating the middle line, with the marks indicating the mid-line and spinous processes at the proper places and the marked portion at such an angle as corresponds to the amount of rotation of the wax strips when laid upon the patient's back, and the pencil tracing taken.

In this way a record is made of the patient's back at the least discomfort to the patient, with the muscles entirely at rest without the disturbance of muscular contraction. What is recorded is the part which it is desirable to be recorded in order to study the comparative results of treatment, namely, the fixed rotation and the amount of structural change and not variations in attitude.

The front of the thorax is not recorded in this way but can be done readily by placing a wax band in a similar way across the front of the thorax with the patient seated or standing. If it is desired to record the patient's condition when standing as well as when lying all that is necessary is to have an assistant hold the hardened wax bands on the patient's back and measure the distance of the wax from a plumb line applied over the middle line of the patient's back, triangulating the distance of marked points of the wax bands from the middle line in the same way as when the patient is recumbent.

It will naturally be found that deviation of the line of the spinous processes as well as the degree of torsion and also the side displacement of different sections of the thorax differs as the patient is seated, standing or recumbent, while but little if any difference is noted in the structural change in the relation of the spines and ribs. If these occur re-softening of the wax band and re-application will be needed for the standing attitude.

The method will be found to be accurate, of easy application, with the patient placed at ease in a desired position with but little danger of varying attitudes. The record thus taken enables the surgeon to see at a glance both the rotation, deviation and side aberration.

ABSTRACTS.

Congenital Scoliosis. Perrone. *Zeit. f. Orth. Chir.*, Band XV, Heft 2–4.

A very rare condition; first case (miscarriage), reported in 1700 by Mery; among 1015 children, between ages of one day and three months, Coville in 1895 found but one case. Three cases from Path. Inst. at Berlin in which congenital origin is unquestionable are described. Author reviews cases in literature, dividing them into three classes, as follows:—I. Cases of pure scoliosis, not associated with other congenital deformities, presenting either (a) an abnormal development of vertebræ or (b) static deformity. II. Cases associated with other congenital deformities in which origin is clear. III. Cases so associated where no cause can be determined. The two points which seem to author of greatest importance are (1) that asymmetry of the sacrum, which occurs by no means infrequently, is to be considered as one of the causes of congenital scoliosis and (2) that the prognosis of such cases is more favorable than of others.—*Henry O. Feiss, Cleveland, O.*

The Location of the Deviation Points of the Spine Based on 884 Cases of Scoliosis and Round Shoulders. By Ernst Hess, Zurich. *Zeit. fur Orth. Chir.*, Band XIV, Heft 2.

As a part of Schulthess' routine the patient bends first to the left and then to the right. In this manner is the position of greatest deviation established and noted.

FOLLOWING IS THE TABLE OF CASES:

Cervico-dorsal scolioses,	25	cases.
Simple dorsal scolioses,	146	"
Complicated scolioses,	248	"
Lumbo-dorsal scolioses,	154	"
Lumbar scolioses,	77	"
Total scolioses,	147	"
Round shoulders,	87	"
Sum total,	884	cases.

Of these 411 are left and 386 are right convex. On each case there was noted the position of the vertebræ or the intervertebral space in which the deviation took place and in certain cases the position of secondary deviations. The 884 cases present bending to the left 944 deviation points including 60 secondary points. In bending to the right there were 911 deviation points, including 27 secondary ones. The essential fact established was that almost all the deviation points lay in the neighborhood of the lumbar vertebræ, more precisely, between the 11th dorsal and the 4th lumbar.

The results are as follows:—1. A concentration of deviation points in both sides in the lumbar column. 2. The dorsal column presents in its lower and middle regions only a small frequency in which the number of right convex deviation points is always greater than the left convex (bending to the right). 3. The averaging of deviation points from the 11th dorsal to the 5th lumbar shows in bending to the left (right convex deviation) a somewhat different result from bending to the right (left convex deviation) inasmuch as the maximum of the right convex does not reach so high as in left convex, and also in that it presents a more uniform distribution over the whole lumbar column, whereas bending to the right presents a greater and higher placed maximum in the inter-spinal space between the 12th dorsal and the 1st lumbar. The deviation points in bending to the right are therefore more typically located than bending to the left. Finally, bendings to the left are to be distinguished by the frequent occurrence of secondary deviation points at the 5th lumbar. Following is the explanation of the frequent occurrence of deviation points on both sides in the lumbar column:—The reason seems to be in the natural tendency for the body to bend in the region of the lumbar vertebræ: this is due to the fact that the dorsal column, owing to its relation to the thorax, acquires a certain stiffening and the lowest part of the column, the sacrum, is a rigid affair.

Analysis of findings for total scoliosis, for round shoulders, for cervical dorsal scoliosis, for dorsal scoliosis, for lumbo-dorsal scoliosis, for lumbar scoliosis.—*Henry O. Feiss, Cleveland, O.*

The Treatment of Lateral Curvature. R. W. Lovett, Boston (*Journal A. M. A.*, June 23).

Considers the subject of lateral curvature, which probably exists to some extent in 25 percent of school children. Two general types are recognized; the postural or functional, and the structural. The first and most common of these is a malposition within the normal range of movement of the spine, and does not necessarily imply any organic change. Its prognosis is good; it is to be corrected by simple gymnastics and a "setting up" drill, thoroughly carried out for a sufficient length of time with conditions rendered favorable. The structural type, of which a characteristic feature is the backward prominence of the chest or loin on the convex side of the curvature, the reverse of that in the postural type, due to the twisting of the vertebræ in addition to the lateral curve, is much more serious and calls for more active measures. Its surgical treatment is considered under two heads: First, treatment to loosen up the spine and to make an improved position possible; second, treatment to secure permanence of the improved position once this is attained. These are discussed separately: The first under the heads of free standing gymnastics, gymnastics given in apparatus, passive stretching of the spine. Stretching by means of plaster-of-Paris jackets (forcible correction), details of all of which are given. Plaster-of-Paris jackets are advised to be employed for short periods (from one to three weeks), and then removed to be replaced by others as long as it seems possible to obtain further correction. These frequent changings are advisable so as to prevent as much as possible the atrophy of the muscles incident to fixation of the trunk. To retain the improved position, the intelligent use of gymnastics is of great importance and details of exercises of the groups of muscles are given to a certain extent. Some form of retentive apparatus should also be employed until the muscles are strong enough to permit its being left off. Lovett insists on the importance of thorough measures in these cases.

Scheme for Mobilizing a Scoliotic Spine after Klapp's Method. By Nieny. *Münch. Med. Wochenschr.*, Jan. 16, 1906.

Klapp advocates creeping on all fours to "enable the scoliotic to acquire motion in the pelvis and the lumbar vertebræ." N. has obtained same results by following exercise: patient grasps swinging ring and while in this position sharply flexes opposite thigh and hooks opposite elbow under knee, retaining this position for several minutes. This exercise is, of course, to be combined with others which tend directly to correction of deformity. N. advocates emancipation from all forms of costly apparatus.—*Walter G. Stern, Cleveland, O.*

The Surgical Importance of the Cervical Rib.

While the supernumerary ribs of the lumbar vertebræ have only an academic interest. those of the cervical region, as Dr. Carl Beck of New York points out (*Journal A. M. A.*, June 17), have a real practical importance. The observations of disturbances due to a cervical rib are multiplying every year. The anomaly may vary from a slight growth just extending beyond the transverse process to a complete rib with a cartilage uniting with that of the first rib. It is bilateral in two-thirds of the cases, but a complete rib on both sides is a rarity. When not complete, or nearly so, it may give rise to no special symptoms, and before the use of the Röntgen ray it was comparatively seldom diagnosed during life, and most of the reported cases were, therefore, accidentally discovered at autopsy. Even when it caused trouble, the symptoms were often credited to tumor or other causes than cervical rib. It is probably, therefore, a more common anomaly than might appear from the small number of cases reported. Though of congenital origin, it does not cause trouble until about the twentieth year, a fact that is hard to explain. The principal symptoms of the anomaly are a hump-like prominence in the lateral cervical region, a superficial pulsation of the subclavian artery and the appearance of pressure symptoms in the brachial plexus. The trouble is a mechanical one, and the treatment, when required, must be surgical. It is just as foolish, Beck remarks, to remove a cervical rib which causes no disturbance as it is to leave one that does cause disturbance until lasting tissue changes have been brought about. At times the technique is very simple, but in the majority of cases difficulties are met, and it should be done only by an experienced surgeon. The difficulty is enhanced by the necessity of removing the periosteum, as otherwise recurrence may be expected. Beck finds that a triangular flap incision, running directly downward along the trapezius and then conducted toward the sternum about one inch above the clavicle, fully exposes the field of operation. If the trapezius cannot be sufficiently retracted with a broad retractor, a transverse incision must be made into the muscle, for, next to a strict asepsis, the success of the operation depends on extensive exposure of its field. The brachial plexus which usually runs across the rib, can be pushed aside; the subclavian artery is best pulled forward. The scaleni are carefully divided at their point of insertion, and this is best done by using a Cooper shears and, advancing layer by layer, lifting the several muscle fibers with the flat of the scissors and using the instrument like a grooved director. By means of a ring-shaped peristeotome the rib is then freed of any small muscular appendages. The division is easy with Beck's beak-shaped rib shears, but some may prefer the Gigli saw. Any remains are nipped off with rongeur forceps.

Congenital Contracture of the Upper Extremities. By E. Rosenkrans. *Zeit. für Orth. Chir.*, Bd. XIV, Ht. 1.

Report of a case of a 10-year-old boy. Motions at elbow limited in flexion and extension. Hands in a position of permanent flexion with some ulnar flexion. Fingers slightly flexed and thumbs adducted. Both arms present shortening and atrophy. The Röntgen picture shows nothing abnormal in the bones. Case comes under the category of congenital contracture of the upper extremities without defect of the bony parts. Not only are deformities of the upper extremities rare compared with the lower extremities, but pure contracture makes the condition still rarer. Author tabulates fifty-five cases reported in the literature. Pathological anatomy shows that certain muscles may be shortened, that there may be anomalies of muscles, that the nerves may be short or tight. The epiphyses of the bones may show abnormalities. A discussion of the etiology, diagnosis, prognosis, and therapy.—*Henry O. Feiss, Cleveland, O.*

Coxa Vara. (An analysis of the material from Hoffa's private clinic.) By Helbling. *Zeit. f. Orth. Chir.*, Band XV, Heft 2-4.

History of affection. Cases reported, 77 in all, are divided etiologically as follows (Alsberg's classification):—A. Congenital variety; (1) without other deformity, (2) as an apparent defect of upper femoral end, (3) with other deformities, occurring either (a) in congenital dislocation of the hip or (b) with congenital deformities of other joints. B. Acquired variety; following (1) rickets, (2) an undetermined disease of youth, (3) osteomalacia, (4) ostitis fibrosa, (5) osteomyelitis, (6) tuberculosis, (7) cystic tumors, (8) arthritis deformans, (9) external violence.

Conception of coxa vara. Alterations in position due to conditions in the joint do not come under the head of coxa vara but by the term is meant changes in the upper femoral end in the sense of varus. According to this definition the alteration may be caused by:—(1) Shifting of axes between head and neck, (2) bending of neck, (3) deviation of neck toward shaft, (4) deviation of shaft below trochanter but still in region of upper femoral end. As a rule combinations of the above are found.

Measurements of angles in 11 cases are given, comparisons made with other authors, and limits below which coxa vara may be said to be present defined. In order to interpret radiographs author uses the epiphyseal line to measure the varus position and obtains angle between this line and the so-called Hoffa line.

Etiology. Coxa vara congenita implies a *vitium primæ formationes* which is manifested in deficient or delayed ossification of upper femoral end. All other forms are to be explained as losses of normal resistence or disproportion between strength of bone and weight borne.

Anatomy. In congenital variety deviation occurs at junction of neck and head: epiphyseal angle is much diminished. In rhachitic cases epiphyseal line (in contradistinction to its perpendicular position in congenital form), runs obliquely downward and inward, so that epiphyseal angle is only slightly diminished. In coxa vara adolescentium location and character of deviation are very variable. In traumatic form of youth the change in shape of femoral end is due to shifting of the epiphysis toward neck.

Clinical picture. Therapy. Various methods of operation; technic of Hoffa's method, oblique subtrochanteric osteotomy. An exhaustive article.—*Henry O. Feiss, Cleveland, O.*

Cases of Congenital Coxa Vara. By Francke. *Zeit. f. Orth. Chir.*, Band XV, Heft 2–4.

F. reports 3 cases in same family which come directly in line with type described by Hoffa (Cf. *Deutsche Med. Wochenschrift*, 1905, No. 32). Hoffa lays great stress on the vertical direction of the epiphyseal line, in contradistinction to the direction in the rhachitic type which is obliquely downward and inward. According to Hoffa's theory, the affection is due to a congenital disturbance in the normal development of the epiphyseal line.—*Henry O. Feiss, Cleveland, O.*

Experiences in Congenital Dislocation of the Hip. Blencke. *Zeit. f. Orth. Chir.*, Band XV, Heft 2–4.

A very early age is best for reduction but children must be old enough to keep themselves clean and body must have lost its rounded form and acquired contours which enable one to mold plaster well. Bloodless reduction is recommended for all cases within proper age limits (up to 8 years for unilateral and 6 years for double cases). The oldest case which B. was able to reduce was 11 years. Proper position in which to apply plaster is that in which head remains most easily in acetabulum; B. includes a part of the other thigh in cast. Out of 97 hips treated bloodlessly by B., there were 31 transpositions, 55 repositions and 11 reluxations, 6 of the latter being eventually reduced, 3 as transpositions and 3 as repositions; this gives 59.8 percent of anatomical cures.—*Henry O. Feiss, Cleveland, O.*

Congenital Dislocation of the Hip. P. LeBreton, Buffalo, N. Y. (*Journal A. M. A.*, October 6.)

After noting the variance of opinion among authorities as to the time when treatment should be instituted in cases of congenital hip dislocation, reports a case in which the dislocation was reduced promptly within three months of the recognition of the symptoms, with excellent functional results, by anterior transposition. He thinks that the delay advised by Lorenz and some other authorities, in this case at least, would have been a mistake. The plaster spica was protected by rubber dam, and there was no trouble as regards soiling.

The After-treatment of Tubercular Coxitis. By Schanz. *Zeit. f. Orth. Chir.*, Band XV, Heft 2–4.

Author aims to show that the best functional results may be obtained by conservative treatment. After healing of the original process, treatment is still required in the majority of cases by a further tendency to deformity, which is no longer due to the disease directly but which is the result of weight-bearing on the softened joint structures and of contracture and shortening of the soft parts surrounding the joint. This indicates that weight must not be thrown upon the hip until after it has regained its facility for weight-bearing. S. attempts to adjust the degree of weight-bearing according to the capacity of the hip; to accomplish this the brace is provided with a spring so arranged that it takes up a part of the weight as soon as it is thrown upon the hip.

Technical Details. By Schanz. Ibid.

1. The spring hip crutch. Description of apparatus mentioned in previous article; spiral springs are attached to the uprights of the brace in such a way as to sustain a part of the body weight.

2. An extension chair. This is used to extend the spine while the patient is sitting comfortably.

3. A modelling chair. For use in making a plaster model of the leg with the latter in the position of walking.—*Henry O. Feiss, Cleveland, O.*

Tuberculosis of the Sacro-iliac Joint. By Zesas. *Zeit. f. Orth. Chir.*, Band XV, Heft 2–4.

Acute and chronic inflammations of this joint are not common, due probably to the fact that it has very slight movement; for, as Bardeleben has shown, the predisposition of a joint to inflammation becomes greater in proportion to its movability. Of the chronic processes tuberculosis is most frequent, occurring chiefly between 20 and 40. Trauma has some etiological importance, especially direct injury.

Pain is the chief symptom, either localized over the joint or radiating to distant parts, as to abdomen, hip or knee; it must be distinguished from lumbago and sciatica; localization of pain is of great importance in differential diagnosis. Not seldom there is a slight limp. Abscesses may point inside or outside the pelvis, the former being more frequent. The result depends on securing ankylosis. Prognosis is most favorable in the dry form (94 percent cures).

Treatment is conservative or operative. Various methods of operation are described, 8 cases of resection from Bardeleben's clinic are reported. Of 94 cases from the literature, 36 were cured, 18 improved, and 29 died. Functional results are not bad, the resected surfaces approximating in time; hence early interference should be resorted to in cases where conservative measures are not followed by rapid improvement.—*Henry O. Feiss, Cleveland, O.*

The Treatment of Tubercular Arthritis in Childhood. By Heffer. *Arch. Internat. de Chir.*, Bd. I. Reviewed in *Arch. f. Orthop.*, H. 1 and 2, Bd. IV.

Most surgeons differentiate the treatment of tubercular joints according to the age of the patient, below the age of twenty the treatment being strictly conservative and above this age operative, unless the progress of the disease is an exceptionally mild one. One reason for this difference lies in the fact that adults cannot usually afford the years of enforced idleness which any conservative method demands. Conservative treatment results in 75 percent of cures, radical operative treatment yields about 70 percent of cures. The advantage of the conservative treatment lies in the preservation of the parts with consequent return of function to a greater or lesser extent. Motion is not however the object of any method of treatment. The goal sought is the *cure* of the tubercular process be the shortening or resultant function what it may. Contractures however are strictly to be avoided by constant fixation in proper position until the time arrives in the course of the treatment when passive motion does not cause reflex muscular contractions. A case is *cured* when all fistulæ have permanently closed and the patient is able to use the part continuously without pain.

Conservative treatment.

Diet and climate are very important factors—sea shore, woods, mountains, sanatoria and open air methods are recommended.

Absolute fixation.

Extension when necessary to relieve undue pressure.

Moderate compression—these three can all be obtained by the use of plaster casts or orthopedic apparatus which can both fix and disburden the afflicted joint; ordinary extension should never be used alone without some supplementary method of fixation.

Absolute rest is required until the pain is relieved.

Injections of 10 c. c. of 10 percent iodoform emulsion are advised.

Bier's congestive treatment should be given a trial.

Contractures are to be relieved by extension apparatus. Redressment force is to be avoided. To avoid fistulæ which complicate the healing process cold abscesses should be left unopened whenever possible.

Operative treatment.

Cases with sequester formation demand operative interference; the latter gives much poorer functional results than does conservative treatment: attempts to obtain perfect function by means of operations have for the most part not been very successful.—*Walter G. Stern, Cleveland.*

Rupture of the Patellar Ligament. By Ombredanne, Paris. *Rev. d'Orthopédie,* Mar., 1906, VII, 2, p. 107.

Following are the conclusions of the author:

At a distance from any surgical center, rupture of the patellar ligament should be treated by placing the limb on an inclined plane, drawing down the patella by means of a bandage, massaging the quadriceps almost immediately, and mobilization of the joint beginning the third week.

This method of treatment may be successful, but there is a great chance of its failing, so that the leg cannot be actively extended on the thigh.

The surgeon, sure of his aseptic technique, should unhesitatingly advise suture of the ruptured patellar ligament. Granted asepsis, complete cure is almost certain.

The best procedure consists in using a large silver wire suture, passing through both the patella and the tibial tubercle. This supporting wire may be single or double.

The kind of superficial suture makes little difference; linen or catgut will do very well, provided they are sterile.

The interosseous suture will give no trouble to the function of the joint.—*William E. Blodgett, Detroit.*

The Flat-foot Series of Disabilities and Deformities of the Foot. By J. M. Berry. *Albany Medical Annals,* Vol. XXVII, April, 1906, No. 4.

The author believes that the term flat-foot is often used ambiguously, and really signifies but one phase of a progressive deformity. There are many phases from pronated foot at one end to rigid flat-foot at the other.

He says that the foot can be considered as a part of the mechanism of the body which under certain conditions is best adapted for work and when these conditions are not present the work is interfered with.

He speaks of the mechanical factors causing flat-foot as follows: 1. A disproportion between the strength of the machine and the work it is called upon to do.

2. Weakness in the machine.

3. Defective support to the machine, disarranging its adjustment and so interfering with its work.

Improper shoeing is a very important element in the causation of flat-foot.

Under pathology he says, "The astragalus is the keystone of the inner arch of the foot.

"In flat-foot it is dislocated forward, downward and inward. The scaphoid is popped outward and the foot is abducted and everted. The middle cuneiform slips downward, the internal cuneiform inward and pressure on the plantar vessels and nerves causes œdema and pain."

All sorts of symptoms are described and there are no certain relations between the degree of deformity and the severity of the symptoms.

Irritability of temper is often found with flat-foot. In the diagnosis of the trouble the author feels that the impressions of the foot on smoked paper are worthless in determining the degree of trouble.

His summary of the treatment is as follows:

Reduction of the dislocation. Retentive splinting. Hot and cold douching. Massage and gymnastics. A proper brace for the foot, and proper shoeing. —*Edward S. Hatch, New Orleans.*

Improvements in the Treatment of Flat-foot. By Hohmann. *Münch. Med. Wochenschr*, May 15, 1906.

In Lange's clinic in order to secure a proper model for making the support, patient is put to bed for several weeks, until pain has entirely subsided and flexibility of foot has been partially restored; then foot is wrapped with plaster bandages and, while plaster is setting, an arch is hollowed out by supinating foot and rubbing sole firmly with ball of hand; when plaster has apparently set, patient is asked to step on outer margin of foot, thus increasing supination; care must be taken not to compress anterior arch. Lange's cork steelwire supports are advocated.—*Walter G. Stern, Cleveland, O.*

The Uric Acid Delusion and the Prevention of Gout. By Woods Hutchinson, Portland, Oregon. *Jour. Amer. Med. Assoc.*, Vol. XLIII, December 3, 1904, No. 25, page 1685

Hutchinson states his conviction, in the light of the clinical and chemical researches of the past fifty years, that uric acid is not the cause of gout. He calls attention to the vast number of pathological conditions now grouped under lithemia or gout, the sole common factor in which is the precipitation of urates in the urine or tissues.

He believes the following to be facts:—

1. Uric acid is not toxic.
2. It is not a result of imperfect combustion of proteids of the urea series.
3. The uric acid appearing in gout is a result of the destructive metabolism of the nucleins of the body tissues, and not derived from the food.
4. The antecedent of uric acid, the so-called purin group, is also, while more toxic, probably a symptom and not a cause of the intoxication.

That gout is analogous to other intoxications is shown by the fact that lead poisoning may give rise to practically all the lesions and symptoms of gout.

Second, a gouty urine may be produced by nearly all the febrile conditions, and by inoculations with modified forms of various infective organisms.

Third, the ingestion of toxic substances, especially fruity wines and malt liquors, is capable of producing the disease.

Fourth, the negative evidence that in certain conditions large quantities of uric acid in urine and tissues fail to give rise to gouty symptoms.

Fifth, the behavior of the paroxysm in gout is not reconcilable with the theory of its causation by uric acid.

Sixth, as Futcher has shown, in gout and mild febrile conditions the rise in excretion of urates, representing the purin moiety, is accompanied by an exactly parallel increase in phosphoric acid in the urine, representing the nucleic acid element.

Hutchinson considers the tophi as merely a symptom of a toxin attacking the joint tissues, and as probably resulting from a local process of tissue necrosis.

He defines gout as "any form of mild, chronic intoxication occurring in an individual of a medium grade of resistance, and resulting in the deposit of uric acid or the urates in the tissues or urine."

As to treatment, the discovery of the particular origin of the intoxication is the essential, involving a searching scrutiny of teeth, eyes, mental condition, or any possible disturbers of normal metabolism, especially the intestinal autointoxications.

He believes the diet question can be answered by directing large quantities of water and "such food as will in each individual case reduce intestinal putrefaction to the minimum, while abundantly supporting strength."—*Robert B. Osgood.*

The Etiology, Pathology, and Classification of Certain Forms of Joint Disease, with a Scheme for the Classification of Joint Diseases Generally. By P. William Nathan, New York. *Am. Jour. Med. Science,* Apr., 1906, CXXXI, 4, p. 636.

In this article, which is one of an unfinished series, the following classification is given:

SYNOVIAL FORMS.

INFLAMMATORY OR INFECTIOUS (Group name.)	TROPHIC. (Group name.)
Tuberculous.	Senile.
Syphilitic.	Metabolic.
Gonorrhœal.	Toxæmic (as with phthisis).
Typhoid, etc.	

OSSEOUS FORMS.

INFLAMMATORY OR INFECTIOUS. (Group name.)	TROPHIC. (Group name.)
Tuberculous.	Senile.
Syphilitic.	Metabolic.
Gonorrhœal.	Neurotic.
Typhoid, etc.	Toxæmic.

William E. Blodgett, Detroit.

"Manifestations of Lithemia in the Spine and Lower Extremities, Simulating Orthopedic Conditions." By Prescott Le Breton, M. D. *American Medicine*, Sept. 30, '05.

Le Breton calls attention to a class of cases, not common but easily overlooked, in which the chief complaint is either backache or pain in the feet. Local tenderness is evident in either case, but associated with it are symptoms on the part of the general system, such as gastro-intestinal indigestion, a lack of energy and of strength, a tendency to dizziness, general nervousness, insomnia, etc., and an abnormal urine.

He cites a number of cases, confirming his diagnosis by the efficacy of his treatment.—*Chas. R. McClure.*

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I.

THE EXCEPTIONAL RACHITIC DISTORTIONS OF THE LEGS.

✓ WALLACE BLANCHARD, M.D., CHICAGO, ILL.

It is a well established principle that the great majority of the rachitic deformities of the legs, including knock-knees, bow-legs and anterior bent tibias, develop along set lines.

It is as necessary in this as in other lines of surgery that the exceptional cases, which are found after considerable experience to recur with some degree of regularity, should be recorded that they may be classed as expected variations.

Operative procedures have been formulated, based upon the unusual evolution of these deformities, and the rules are not impaired by the occasional exceptions that occur.

CASE 1.—Eleanor B., aged four years, with bilateral rachitic knock-knee of pronounced type producing difficult locomotion. The deformity is very well shown in the cut, Fig. 1, made from a photograph.

The primary deviation was, as is usual, an in-bend in each upper tibial shaft. As the in-bends in the tibias increased a strong leverage was exerted upon the femurs, causing them to gradually lose their normal out-bends. This loss of the normal out-curves of the femurs became so pronounced that it more than divided the deformities with the tibias. This is well shown in the skiagram, Fig. 2, taken before correction. The skiagram also shows that the epiphyses are practically normal.

In view of the conditions described a supracondyloid osteoclasis was performed. The over-correction at the seat of fracture sufficiently exaggerated the existing out-bend of each femur to more than restore the normal out-bend and also to compensate for the in-bend of the corresponding tibia.

It is usual at the age of four years that almost any amount of supracondyloid over-correction may be made with only an osteokampsis or partial fracture resulting, but in this case eburnization had been early and consequently the fractures were both quite complete.

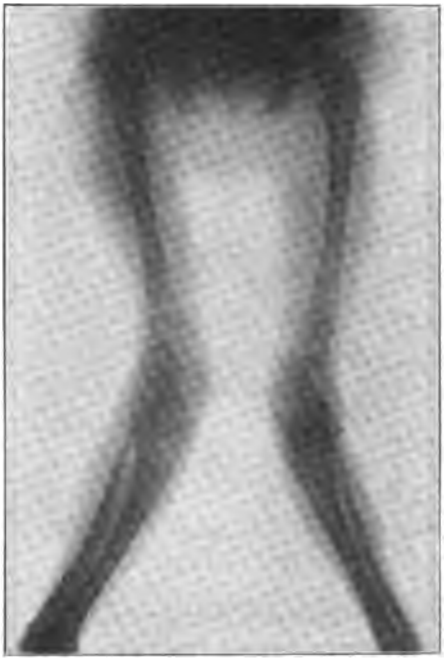


FIG. 2. Skiagram of Case 1, Eleanor B., before correction, showing the deformity to be due to distortions of the diaphyses of the bones while the epiphyses remain practically normal.

The second skiagram of the case, Fig. 3, taken six weeks after the operation, shows that considerable space was opened up between the fractured ends. It may be said in parenthesis that if the bone deformities had remained confined to the tibias the only logical points of correction would have been at the apex of each deformity bend in those bones. The primary deformity bends of the tibias still remain, as is plainly seen in the skiagram, but

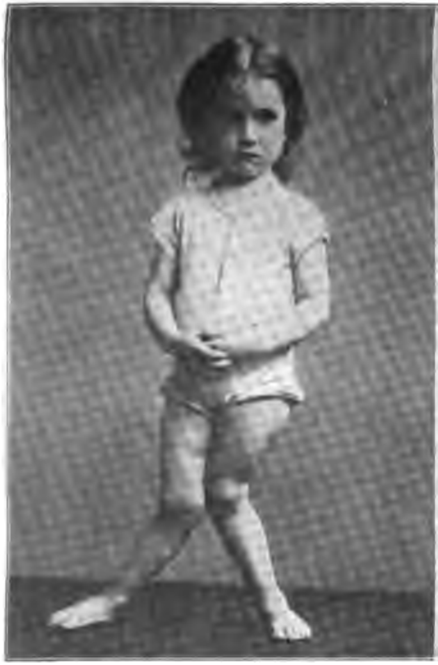


FIG. 1. *Case* 1. Eleanor B., knock-knees.

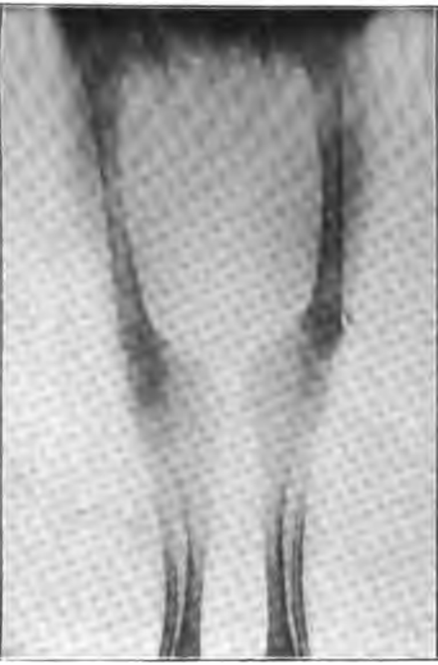


FIG. 3. Skiagram of Case 1, Eleanor B., after correction.

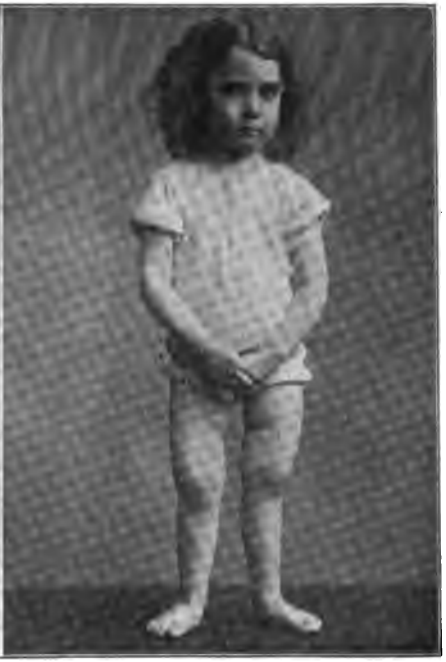


FIG. 4. Case 1, Eleanor B., after correction by supracondyloid osteoclasis and showing resulting symmetry of the legs.

the over-correction of the femurs has neutralized the in-bends of the tibias, producing symmetric and useful legs, as is shown in Fig. 4, which is made from a photograph taken six weeks after the correction of the deformity.

CASE 2.—Ella G., aged four years, with pronounced rachitic bow-legs, as illustrated in Fig. 5. In this case the primary deviations were an out-bend in each lower femoral shaft and the secondary and more pronounced out-bends developed in the tibias placing the apex of each deformity between the middle and the upper third of the tibia, as will be seen in the skiagram, Fig. 6, taken before correction. The skiagram also shows that the epiphyses are practically normal.

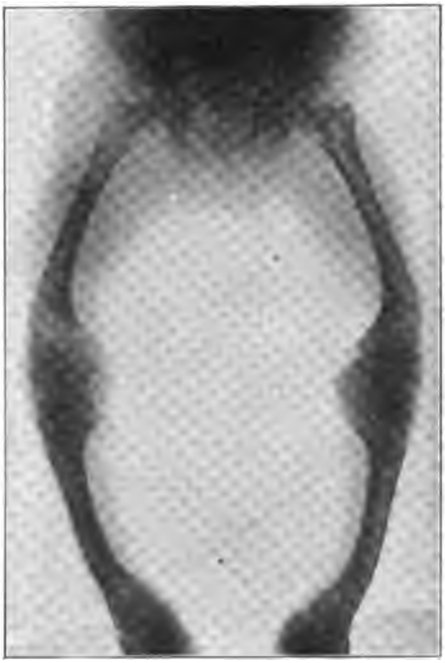


FIG. 6. Skiagram of Case 2, Ella G., before correction, showing the deformity to be due to distortions of the diaphyses of the bones while the epiphyses remain practically normal.

Usually at this age the tibias are sufficiently pliable under the pressure of the osteoclast to permit of marked over-correction without fracture and with the long distributed bend of an osteokampsis. Less frequently at the fourth year the tibias take about

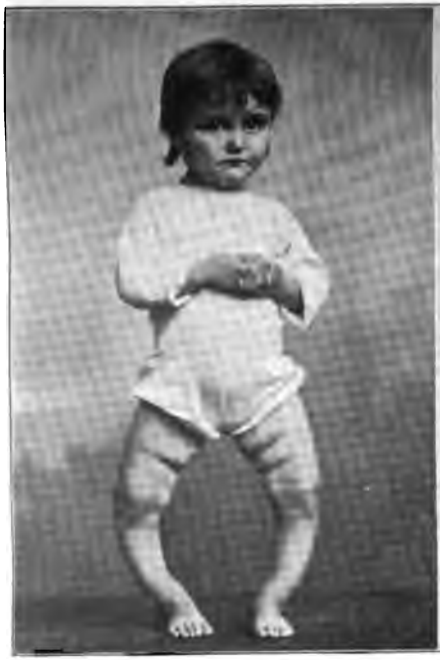


FIG. 5. *Case.* 2, Ella G., bow-legs.

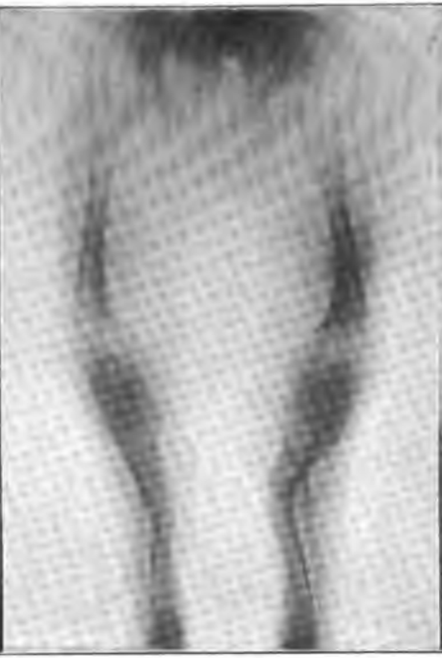


FIG. 7. Skiagram of Case 2, Ella G., after correction of the deformity by rapid osteoclasis, and revealing acutely defined angles at fracture points.

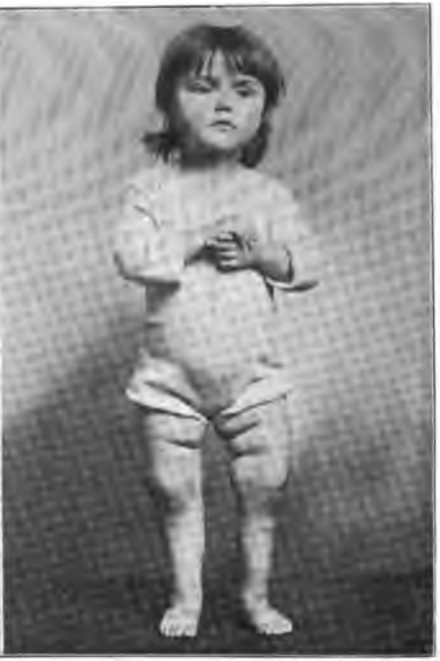


FIG. 8. Case 2, Ella G., showing that the exaggerated over-correction at one point has neutralized the other out-bends and has assimilated into the general contour, producing symmetric legs.

three-fourths of a pronounced over-correction in a long bend and the over-correction is completed with a partial fracture. This case is an extreme example of early hardening of bone occurring after rickets. The tibias were fractured by rapid osteoclasis at the apex of each deformity. The over-correction at the points of operation was advanced sufficiently to neutralize the out-bends of the femurs as well as to correct the out-bends of the tibias.

The second skiagram of the case, Fig. 7, taken six weeks after the operation, shows that the tibias refused to bend even slightly under the pressure of the osteoclast. It also shows that the tibias took all of their over-correction at the seat of fracture, leaving acutely defined angles at these points. A month after the operation the bones had become solid in their extremely over-corrected position.

The great over-correction at one point neutralized both tibial and femoral out-bend deformities and had assimilated into the general contour so that when the plaster was removed the patient walked on symmetric legs, as is seen in Fig. 8.

This case must be considered only as an extraordinary example. It is manifestly advisable, when practical, to secure perfect results with one operation and it is very seldom, indeed, that more than one-fourth to one-half of the over-correction shown in this case at the seat of fracture, is necessary to correct the most pronounced of deformities. The case is interesting as showing to what an extreme extent over-correction at a single point may be carried and still assimilate into straight legs.

Case 3.—John A., aged four years, with badly deforming rachitic bow-leg of the right side and knock-knee of the left side, as will be seen in Fig. 9, producing difficult locomotion.

In the bow-leg of the right side the primary deviation had been an exaggeration of the normal out-bend of the femoral shaft followed by a secondary out-bend of the tibial shaft, and the latter became the most pronounced. Rapid over-correction was made with Grattan osteoclast at the apex of the deformity in the tibia.

The skiagram of the case, Fig. 10, taken two months after the correction of the bow-leg, shows the operation to have been a typical osteokampsis or bending of incompletely eburnized bone. This osteokampsis is typical of a large proportion of the cases of rachitic deformity of the legs in children from three to five years of age.

The consideration of the left leg in this case presents several

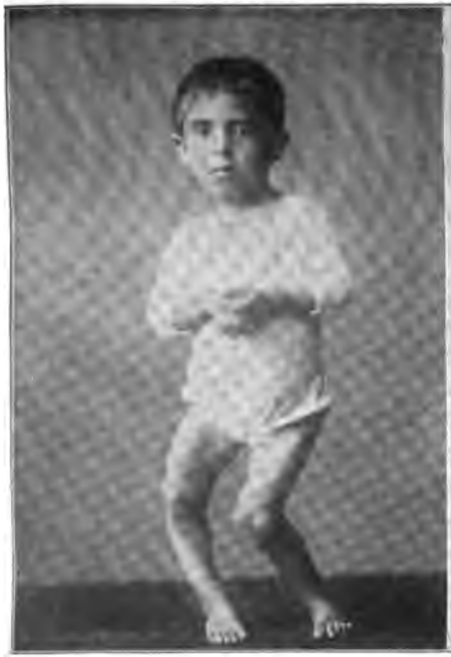


FIG. 9. *Case* 3. John A., with bow-leg of the right side and knock-knee of the left side.

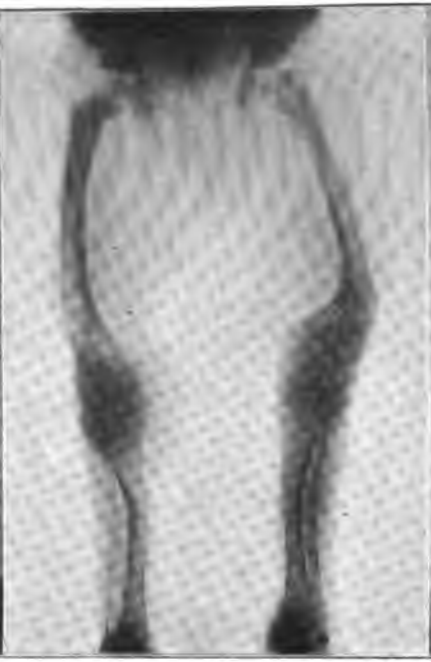


FIG. 10. Skiagram of Case 3 after correction, revealing coxa valga of the left side.

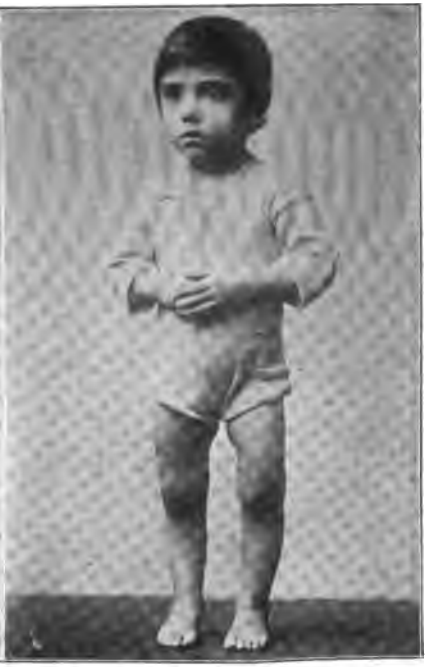


FIG. 11. Case 3, John A., after correction by rapid osteoclasis and showing resulting symmetry of the legs but slightly marred by a flattening of the outside of the left thigh due to coxa valga.

interesting features. It is unfortunate that no skiagram was taken before the operation.

The bow-leg of the right side had removed the usual support which a knock-knee receives from its fellow, at the median line in bilateral knock-knee or slightly past the median line when the other leg is normal. The only stop to the adduction excursion of the left knee was a long leverage pressure of the neck of the femur on the lower rim of the acetabulum. This may account for the development of a deformity of the neck which was unsuspected until the knock-knee, which was the more apparent deformity, had been corrected.

A supracondyloid osteoclasis was decided upon because it was apparent that the femur participated largely in the deformity. The operation perfectly corrected the knock-knee, as will be seen in the second picture of the case, Fig. 11, taken six weeks after the operation.

When the plaster was removed at the end of the fourth week the outside of the left thigh was found to be flattened, as will be plainly seen in Fig. 11. There was a marked recession of the trochanter major and the upper femoral shaft.

The skiagram, Fig. 10, disclosed a rachitic coxa valga of exceedingly pronounced type. The head and neck are plainly seen to be nearly on a straight line with the shaft of the femur. The possibility of any rotation or twisting of the upper femoral shaft magnifying the extreme deflection of the neck, as shown in the skiagram, is precluded by the clearness with which both the trochanters, major and minor, are seen.

Kölliker says that coxa vara and coxa valga may be said to express changes in the angle of incidence formed by the neck and the shaft of the femur.

Allsberg's rule for determining the relations of the neck and the shaft seems likely to meet with general adoption. A line in a plane passed through the base of the head of the femur will form an angle with the long axis of the shaft of the bone, which is Allsberg's angle of elevation, measuring on an average 41 degrees, but according to Hoffa it may vary in normal conditions from 29 degrees, which verges upon coxa vara, to 50 degrees, which approaches coxa valga.

In this case the neck which appears nearly on a line with the shaft measures 75 degrees, Allsberg's angle of elevation.

Over 20 cases of rachitic coxa vara have been seen at the Home for Destitute Crippled Children and this is the first case of rachitic coxa valga observed. It may, therefore, be fair to conclude that coxa valga is a comparatively rare rachitic deformity.

It is interesting to observe that while the articular plane of the right knee is shown in the skiagram, Fig. 10, to be practically level, that of the left is tilted 30 degrees, giving a deceptive appearance of elongated and shortened condyles. This tilt is the result of two factors, the first being the rachitic in-bend of the upper tibial shaft, which changed the direction of the head of the tibia, and the second the redressment at the point of the supracondyloid osteoclasis. This redressment consisted of an increase of the normal out-bend in the lower femoral shaft and this operated out-bend in the femur was carried far enough to neutralize the pathologic in-bend in the tibia.

A cuneiform osteotomy at the neck is undoubtedly the proper operation for the correction of coxa valga; nevertheless, the increased out-bend at the seat of osteoclasis in the lower femoral shaft serves as a somewhat distant substitute for a normally inclined neck. This result is remarkably effective, considering its remoteness from the deforming coxa valga. The range of motion is practically normal in both knee and hip-joints and function is perfect. The boy stands with a level pelvis and walks without a limp. The only blemish on a most excellent result is the flattening of the outside of the left thigh, and that will never be noticed unless special attention is directed to it.

Upon several occasions imperfect results have been observed due to the failure of the operators to follow the fairly well established rules of procedure.

A supracondyloid osteoclasis should almost invariably be done from the inside with the fracturing bar placed just above the inner condyle, and the line of fracture will always be at or very close to Macewen's line. One reason for not doing a supracondyloid osteoclasis from the outside is that it greatly increases the danger of an epiphysiolysis.

Osteoclasis of the tibia should never be done from the inside of the leg. When the fracturing bar of the osteoclast is placed against the inside of the tibia the fibula usually does not break with the tibia, but instead it only bends and pulls upon its distal attachments. In this situation it is nearly impossible to fracture the fibula and redressment becomes unnecessarily complicated. In osteoclasis of the tibia the fracturing bar of the osteoclast should always be placed against the outside of the leg without regard as to whether the tibia is to be ultimately redressed with an exaggerated in-bend for the correction of the bow-leg, or an exaggerated out-bend for the correction of knock-knee. When the osteoclasis is performed with the fracturing bar against the outside of the leg the fibula invariably breaks, either before or with the tibia, and never offers the slightest obstruction to redressment in any direction.

The operator in fracturing the tibia for the correction of knock-knee should not hesitate to temporarily more than double the deformity in-bend of the upper tibial shaft. The pressure bar should be pushed with the greatest possible rapidity until the tibia fractures. Then remove the osteoclast and redress the tibia in the opposite direction by manual force to any desired position of correction or over-correction.

In correcting an anterior bent tibia it would be decidedly disastrous to direct the fracturing bar of the osteoclast against the front of the anterior bend. The tibia must be fractured laterally and the deformity should be corrected by opening up a triangular space between the fractured ends of the bone by manual force. If the deformity is very pronounced its correction will lengthen the leg an inch, making tenotomy of the tendo Achillis a necessary first step of the operation.

The full possibilities of rapid osteoclasis are only beginning to be appreciated. The term rapid osteoclasis is limited in this application to eight seconds pressure in the osteoclast to accomplish a complete osteoclasis or osteokampsis.

The X-ray is constantly revealing new pathologic distinctions and has become an invaluable assistant in the study of rachitic bone distortions. It brings distorted bones and joints plainly into view and indicates clearly to the operator the direction and the degree of redressment necessary to obtain normal positions and outlines, thus making it possible to correct rachitic deformities of the legs with almost mathematical precision.

The pathological study of the cases presented is based on skiagrams taken before after operation and the rapid correction by the aid of the Grattan osteoclast of 800 cases of rachitic deformities of the legs furnishes the data for comparison of the usual with the unusual cases presented.

It is quite evident that the exceptional as well as the usual cases should be studied and classified in order to place the operative technique, both general and exceptional, upon a firm basis.

Apparent perfection has been reached in the Grattan osteoclast, and osteoclasis is the most practical as well as effective and rapid method of correcting rachitic deformities of the legs. The rules of procedure that have been adopted after considerable experience are not in the least impaired by the deviations made necessary by the exceptional cases that have been tentatively classed as occasional or rare variations.

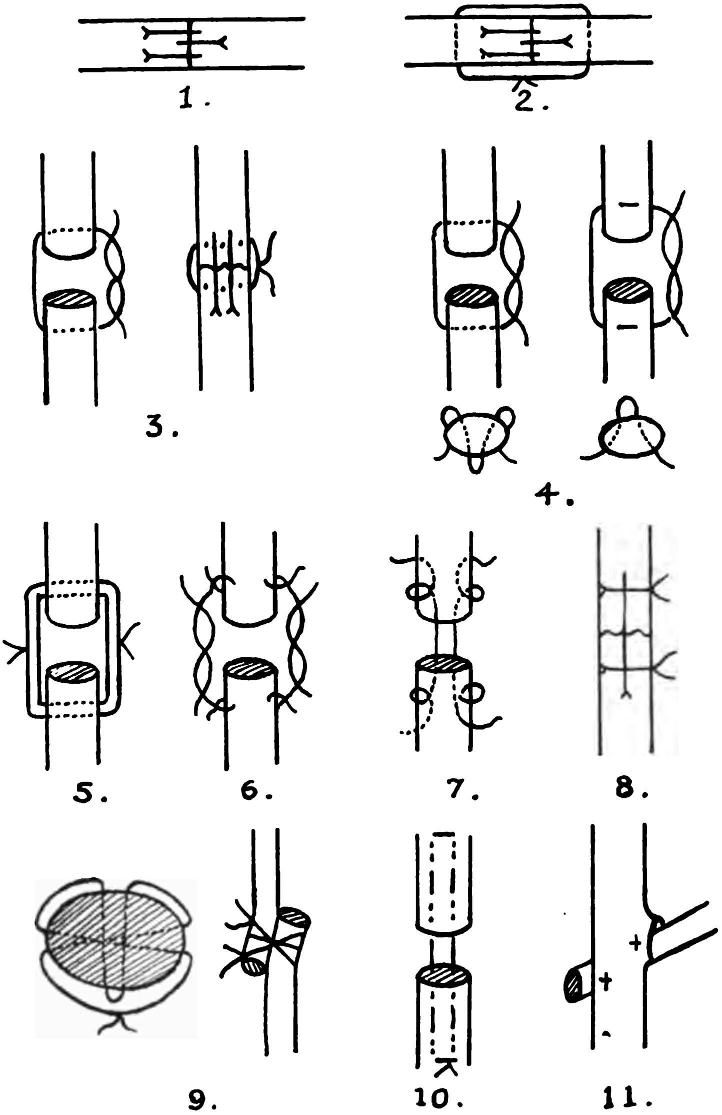
II.

AN EXPERIMENTAL STUDY OF THE INFLUENCE OF NECROSIS, PRODUCED BY SUTURES, IN TENDON SUTURE AND TRANSPLANTATION.

BY DAVID SILVER, PITTSBURGH, PA.

The first requirement of any method of suture is that it afford sufficient strength to maintain apposition during the process of repair; the second, that it shall not exert sufficient tension to produce necrosis. In the repair of divided tendons and in tendon grafting certain peculiarities of the tissue involved render it more difficult to meet these requirements. A secure hold for the suture is harder to obtain since the union between the tendon bundles is not a firm one and readily yields to a comparatively slight pull in the direction of the fibres. The connection of the muscle with the tendon subjects the suture to a greatly increased strain: in repair of divided tendons, if the ends are brought in contact, the suture is subjected to a considerable constant strain from tension due to normal muscle tone, and further to an intermittent strain from involuntary muscular contractions, such, for example, as may occur during recovery from the anesthetic; in tendon grafting the constant strain is greater, since suture under high tension is necessary (Lange, Hoffa, and others). Also to be mentioned, as affecting the question of necrosis, is the poor blood supply of tendon tissue.

On account of the character of the tissue and the tension which the suture must withstand, the interrupted suture, the oldest and simplest method, does not offer sufficient security, and hence various other methods have been suggested for obtaining the necessary hold on the tendon. The majority of these may be



Methods of Suture.

1. Simple suture. 2. Le Dentu. 3. Hagler. 4. Wofler. 5. Trnka. 6. Eiselsberg. 7. Wilms and Sievers. 8. Schwartz. 9. Suter. 10. Lange. 11. Goldthwait.

divided into two classes. In the first the originators seem to have considered constriction of the tendon fibres harmful and, by an ingenious placing of the suture, have obtained a firm hold without undue compression; of these methods Hagler's, Wofler's, Trnka's, and Lange's are the best examples. In the second class the possible evil effects of constriction have evidently been disregarded; in the methods of Eiselsberg and of Wilms and Sievers only a few fibres are encircled by the suture, while in that of Schwartz the entire tendon, and in the one recently proposed by Suter almost the entire tendon is included. In all of this class the degree of constriction increases proportionately with the increase in tension under which approximation is maintained. In those methods not falling in these two classes, methods which have been used especially in tendon grafting, a firmer hold has been obtained by first buttonholing the tendon, or passing it through a canal in the bone, and then suturing it with interrupted sutures, thus constricting a greater or less number of fibres.

There can be no doubt that many of the failures in tendon suture and transplantation are due to insufficiency of the suture. This may be the result of insufficient hold on the tendon or of insufficient strength of the suture material. The question suggests itself as to whether or not it may also be due to yielding through necrosis of the tendon from over-tight sutures. That a certain amount of necrosis does occur, we already know. Hoffa states in the report of his experimental work that degeneration of the tendon bundles constricted by the different sutures can be clearly recognized and he describes the processes of destruction and repair. Also Seggel, who studied the process of healing after the use of Lange's silk tendons, says that the placing of the sutures always produces widespread traumatic injury, which can be observed for a long time, but that the high degree of interweaving of the tendon, as carried out in Lange's method, does not appear detrimental in spite of this injury. *Not, therefore, whether necrosis of tendon tissue does occur but whether it may reach such a degree as to endanger the stability of the suture is the question to which the investigations reported in this paper have been directed.*

Nicoladoni, whom it is fitting to quote first in any discussion of tenoplasty, expressed the opinion in his early writings that the ends of the tendon should be held in the barest possible apposition by very delicate sutures under little tension and with the avoidance of all compression. Trnka, in reporting his method of suture by lengthening, advises that the sutures be not drawn tight, in order that the nutrition of the split portion may not suffer. Also Vulpius speaks of placing the sutures so that only a portion of the tendon be encircled, so as not to endanger its vitality.

After mentioning the various methods of suture, Lange says: 'This complicated suturing, amounting to a partial ligature, carries with it the danger of producing necrosis of a portion of the tendon. Especially dangerous is the method of Schwartz. * * * * * A part of the failures in tendon suture is certainly to be referred to necrosis of the ends of the tendon." And again he states: "In the firm suturing of the ends of the tendon, which we must strive to obtain, the greatest danger is that portions of the tendon become necrotic, the portions most endangered being those immediately next to the cut surfaces."

In general works on surgery but little attention is paid to the details of suturing. The only direct reference to necrosis found is in Ochsner's Clinical Surgery, where it is stated: "It is of the greatest importance to avoid tension. In applying sutures to tendons tension should be avoided and the sutures never tied tightly enough to cause pressure necrosis, because tendon is a tissue not well supplied with blood, and consequently easily injured in this manner." Another surgeon of international reputation made to me personally a statement similar to that of Ochsner, saying that he tied the sutures very loosely.

Evidence on the other side of the question is very meager, unless the silence of most authors be considered in favor of the nonoccurrence of necrosis.

Wollenberg studied the arterial supply of muscles and tendons by taking radiographs of specimens in which the vessels had been injected with mercury. He was not able to demonstrate, either in the new-born or in adults, arteries which started from the muscle belly or from the insertion into the bones or ligaments and ran directly in a longitudinal direction into the interior of the tendon; if the areolar sheath was dissected away exactly, almost no injected vessels were visible. Ancoleo, quoted by Freiberg, has shown experimentally that the intactness of the sheath is necessary for the perfect nutrition of the contained tendon; but, on the other hand, that complete removal of the sheath is not followed by necrosis of the tendon. Granting, therefore, that no important vessels reach the tendon except from the sheath, and that the tendon does not become necrotic even when the sheath is removed, it follows that the tendon must, under these circumstances, receive sufficient nutrition through the lymphatic stream and (or) by imbibition to withstand necrosis until the reestablishment of the circulation takes place.

That tendon tissue is capable of retaining its strength a sufficiently long time even when entirely removed from the circulation, we know from the successful results in filling out defects in tendons with pieces of tendon taken from animals (Gluck, Helferich, Peyrot, Monot). Bickham, in his work on operative surgery, mentions this as a recognized procedure.

It is evident, moreover, from the description of the technique at Gluck's clinic, quoted by Klare, that necrosis is not greatly to be feared. "They use here" it is stated, "both fine and coarse silk, fine and coarse catgut, large and small, straight and curved, single- and double-edged needles; the tendons are pierced lengthwise and crosswise; the sutures are simply passed through the ends of the tendon or the ends are encircled; the results are always good; the principle requirement is that the suture material be sterile and the wound kept aseptic."

In order to determine, if possible, what the real danger of necrosis is, three series of experiments were performed on rabbits. In the first series the effect of the highest degree of constriction on the reinforced tendon was investigated; in the second, its effect on the reinforcing tendon; in the third, its effect on both after transplantation. Since the object sought was to determine whether, under these circumstances, sloughing will result or sufficient softening take place to allow the sutures to cut out, the specimens were examined macroscopically only, dependence being placed on the change in color and consistency of the tendon, the number of fibres cut, the amount and location of the tissue proliferation, and the strength of the graft.

Report of Experimental Work.

The technique in all cases was similar. The skin over the outer aspect of the leg having been shaved and cleansed with corrosive sublimate solution, an incision was made through the skin and fascia anteriorly to the tendo Achillis. Retraction of the loose skin gave free access to the tendo Achillis and the tendons on the outer aspect of the leg. Hemorrhage was usually slight and, on closing the incision, the field of operation was quite dry; in one or two cases there was some subsequent bleeding from injury to vessels in suturing the skin. For suturing and ligating the tendons, silk, No. 8–13, and usually the heavier sizes, was used in all cases. The skin was closed with a continuous suture of silk-worm gut. A collodion dressing was applied and in the second and third groups the leg was immobilized in plaster-of-Paris. There was singular freedom from infection, the only evidence being in two cases in the first group in which a few drops of a thick, white fluid were found between the skin and fascia (stitch abscess) and in one case in the second group in which the infection seemed to start from injury to the parts just below the site of operation.

Series I.—*To determine the degree of necrosis of tendon tissue produced by sutures tied under the highest possible tension, the tendon being left intact.*

Operation.—The tendo Achillis was exposed and ligated with two silk ligatures, with the exception of the two twelve-day cases in which a single ligature only was used. The ligatures were placed about a quarter of an inch apart. No plaster was applied, the use of the leg being permitted.

There was in all cases considerable reaction, a spindle-shaped thickening forming around the ligated portion. The ligatures were usually found somewhat nearer together than when placed and in the older specimens, were firmly embedded. The cut fibres were slightly softer and duller in color than normal tendon.

For convenience in comparison, a tabulated report is given.

TABLE I.—REPORT OF OPERATIONS IN SERIES I.

Interval.	Effect of Ligature on Tendon Tissue.	Condition of Uncut Fibres.	Union of Cut Fibres.
11 days.	About ½ of fibres cut.	Normal.	
12 "	Areolar sheath only cut.	"	
12 "	About ⅓ cut.	"	
13 "	A few fibres only cut.	"	
18 "	" " " "	"	
18 "	A few fibres cut.	"	
19 "	A few fibres only cut.	"	
19 "	Fibres not cut but tendon changed into a tough, gelatinous colored tissue from a few mm. above ligature to same distance below.		
20 "	A few fibres only cut.	"	
25 "	About ¼ to ⅓ cut.	"	Firm.
30 "	About ¼ cut.	"	"

SERIES II.—*To determine the degree of necrosis of tendon tissue produced by sutures tied under the highest possible tension, the tendon being divided.*

Operation.—The tendo Achillis was transfixed, ligated and divided about ¼ inch either above or below the ligature. The leg was fixed in plaster.

TABLE II.—REPORT OF OPERATIONS IN SERIES II.

Rabbit.	Interval.	End Ligated.	Condition of Ligated End.	Condition of Unligated End.
1.	7 d.	Prox.	Normal; no tissue proliferation.	Normal; moderate proliferation.
..	..	Distal.	As above.	As above.
2.	14 d.	Prox.	Normal; small callus.	Normal; small callus.
..	..	Dist.	As above.	As above.
3.	18 d.	Prox.	Normal; fair callus.	Degenerated from abscesses originating beyond field of operation.
..	..	Dist.	As above.	Normal; fair callus.
4.	21 d.	Prox.	As above.	As above.
..	..	Dist.	As above.	As above.
5.	28 d.	Prox.	As above.	As above.
..	..	Dist.	As above.	As above.
6.	35 d.	Dist.	Very slightly softer than normal; slight evidence of inflammatory thickening.	As above.

A tabulated report seems sufficient. As there is always a slight dulling in color of the tendon due to the reparative process, the condition of the tendon is reported as normal when no further change is present.

SERIES III.—*To determine the degree of necrosis of tendon tissue produced by sutures tied under the highest possible tension, when one tendon is grafted into the other.*

Operation.—The tendon of the flexor communis digitorum was isolated and divided near the heel. The tendo Achillis being then exposed, a pair of mosquito forceps was passed through a slit near its upper end and the proximal end of the flexor communis seized, drawn through, and sutured in place under moderate tension with from 4 to 6 silk sutures, which were tied as tightly as possible and so placed that all the fibres of the two tendons were included. The portion of the flexor communis crushed by the forceps was left intentionally.

1. Left leg. Examination after 9 days. The reinforcing tendon is *in situ*. The evidences of repair around the point of transplantation are slight; only at the point where the flexor communis enters the tendo Achillis is there any evidence of tissue proliferation. The end of the flexor communis is slightly softer and duller in color than normal; otherwise both tendons appear unchanged. On carefully removing the sutures, trifling force is sufficient to produce separation of the reinforcing tendon from its attachment.

2. Right leg. Examination after 10 days. The end of the flexor communis has pulled out of the slit in the tendo Achillis but lies in contact with it, being held in position by adhesions to the surrounding tissue. There is no evidence of necrosis of either tendon.

3. Left leg. Examination after 11 days. Around the point of the transplantation the tendons are slightly adherent to the sheath and adjacent tissue and to each other. The former course of the flexor communis is filled with a soft gelatinous mass. On removing the sutures, the reinforcing tendon pulls out as soon as tension is put upon it. Examination of the tendons after separation shows an apparently normal condition, except for the crushed

end of the flexor communis, which is softened and changed to a dull gray color.

4. Left leg. Examination after 12 days. There is considerable thickening around the graft and the sheath of the flexor communis below this point is filled with soft new tissue. The implanted tendon is *in situ*. The sutures are rather deeply embedded. After their removal, a force of ½ lb. is required to produce separation. Both tendons appear practically normal, even the crushed end of the flexor cummunis showing almost no change.

5. Left leg. Examination after 13 days. The graft is well covered anteriorly by a thin layer of fibrous tissue to which it is firmly adherent. The reinforcing tendon has almost entirely pulled out; its end has the same appearance as previously described. The tendo Achillis is normal in appearance.

6. Right leg. Examination after 14 days. The tissues are more moist than normal, especially around the point of transplantation. There is considerable tissue proliferation all round the graft, which is *in situ*, and the former course of the flexor communis is filled. After removal of the sutures, separation is produced by a force of 5¾ lbs. The end of the reinforcing tendon is slightly softened and duller in color. The tendo Achillis shows no signs of cut fibres nor of change in consistency or in color. There is no evidence of adhesions on the portions of the tendons in direct contact (in the slit).

7. Right leg. Examination after 15 days. The same moisture as in the last case is noted. There is considerable tissue proliferation extending from the point of the graft downward in the course of the sheath of the flexor communis and of the skin incision; the graft itself is surrounded by a moderate amount of new tissue. The flexor communis is *in situ;* after removal of the sutures and freeing it from the adhesions formed in the old sheath (which was not done in the last case), a force of 2¼ lbs. is required to produce separation. The end of the flexor communis has a slightly duller appearance and is very slightly softened; there is no evidence of adhesions on the portion which passes through the slit in the tendo Achillis. On the tendo Achillis the

indentations of the sutures are visible but no cut fibres can be seen and the color is normal.

8. Left leg. Examination after 18 days. There is considerable tissue proliferation of firm consistency around the point of the graft and the former sheath of the flexor communis is filled. On removing the sutures, only a few fibres of the transplanted tendon are found *in situ;* the remainder, having pulled out, are lying in close proximity to the tendo Achillis. That the tendon has pulled out and not degenerated is evident from the absence of any signs of necrotic material in the slit in the tendo Achillis and from the length of the tendon. The end of the flexor communis and the tendo Achillis present the same appearance as in former cases. Even if the end of the flexor communis had become adherent to the tendo Achillis at the point at which it was lying, its pull would have been largely expended on its former sheath and on the surrounding tissue.

9. Examination after 20 days. Tissue proliferation is similarly distributed but somewhat greater than in former cases. The end of the flexor communis is *in situ* and requires a force of 2½ lbs. to produce separation; it is slightly less glistening than normal but shows no evidence of necrosis of the tendon bundles and there are no signs of adhesions on the surface in contact with the tendo Achillis. No fibres of the tendo Achillis have been cut and there is no apparent change in color or consistency.

10. Left leg. Examination after 25 days. The tissues have a dry, more normal appearance than in previous cases. Tissue proliferation is limited to the immediate region of the graft and the sheath of the flexor communis. The new tissue is firmer than heretofore. Tissue formation along the former sheath of the flexor communis is so situated that the pull of the transplanted muscle would be partly expended upon it. The graft, which is *in situ*, is surrounded by a spindle-shaped thickening; it yields to a pull of 5½ lbs., after the sutures are removed. The end of the reinforcing tendon is only slightly less glistening and a little softer than normal; the surface in direct contact with the tendo Achillis shows macroscopically no signs of adhesions. The tendo

Achillis is apparently normal, only the indentations of the sutures being visible and no fibres being cut.

11. Left leg. Examination after 30 days. The tissues present the normal degree of moisture. There is considerable fibrous thickening at the point where the tendon of the flexor communis enters the tendo Achillis. The new tissue in the sheath of the flexor communis is less in amount than formerly and not enough to absorb part of the pull of the muscle as was the case in the last specimen. The graft is *in situ* and the sutures firmly embedded. On testing the force necessary to cause separation, the tendon itself breaks about a half-inch above the point of implantation under a pull of 5 lbs. and on a second trial breaks again closer to the point of insertion. The end is firmly adherent to the slit in the tendo Achillis. The appearance of the tendons is the same as in previous specimens. The breaking of the tendon is probably due to its being cut by the sharp teeth of the hemostat used in grasping it, a smoother one having been used previously.

12. Left leg. Examination after 35 days. The tissues have the normal condition as regards moisture. There is less thickening about the graft and less new tissue in the sheath than in the earlier cases but it has a firmer consistency. Proliferation is more marked posteriorly where the sheath is intact than anteriorly where it is absent, a fact also noticed before. The graft is *in situ*. A force of 5 lbs. is required before separation begins but, owing to the fact that a few fibres of the flexor communis were overlooked in transplantation, the force required cannot be accurately determined. There is no evidence of adhesions on the portion of the reinforcing tendon passing through the tendo Achillis. Except for the adhesions incident to repair, the two tendons appear normal.

DISCUSSION OF RESULTS.

In considering the results of these experiments, two factors need emphasis:—(1) The tension of the sutures was the highest obtainable, and (2) traumatism was relatively much greater than in man. This increased traumatism was due to the relatively longer incision required, the more delicate character of the tendons, and the relatively coarser silk and larger needles used.

In the first series ligature without division gave 6 cases in which only a few fibres, or none at all, were divided; 4 cases in which from ¼ to ½ of the tendon was divided; and 1 case in which the portion included by the ligatures was completely changed. In the last mentioned the fact that the change extended a little beyond the ligatures suggests the possibility of stretching of the degenerated portion; the character of the tissue in this case resembled that in an advanced stage of healing after tenotomy; its consistency was certainly sufficient to withstand great force. In all the other cases the undivided portion of the tendon was entirely normal and capable of withstanding any amount of functional use.

In the second series, ligature with division, no especial change in the portion of the tendon constricted by the ligature could be noted. In the very early specimens tissue proliferation about the ligated end seemed to be delayed.

The behavior of the reinforced tendon in transplanation differed materially from that in the first series. In no case were any fibres of the reinforced tendon divided, althongh in each one a ligature had been thrown around the entire tendon. The explanation of this, it seems to me, is to be found in the fixation of the part; without fixation the strain on the tendon at the point of ligature is greatly increased each time a muscular contraction puts the tendon on the stretch. The end of the reinforcing tendon was practically normal in every case, the only change being a slight softening of the superficial fibres and a slight dulling in color, changes similar to those which occurred after division without ligature.

Up to the thirtieth day there were no signs of union to be observed macroscopically on those portions of the tendon in direct contact. This was in contrast to the behavior of the ligated ends in Series II, in which in all but the earliest specimens the cut surfaces were firmly united to the callus. Two explanations may be offered for this:—(1) Interference with the circulation following separation of the tendon from the surrounding tissue for such a large part of its length, and (2) absence of the sheath from the anterior portion of the graft. Were the circulation of the end of the reinforcing tendon maintained, one would expect to find signs of tissue proliferation before the thirtieth day. It is difficult to understand, however, how it can be maintained when the tendon is separated from all the surrounding tissue for a half to two-thirds of its course; furthermore, in practice, the tendon may be subjected to still further traumatism by being split and drawn through a new channel in the connective tissue, and yet this is done with impunity. The importance of the sheath, which on account of the small size of the parts it was not possible to suture, was clearly demonstrated. Tissue proliferation was most abundant on the internal surface of the graft where the sheath was intact and also in the course of the old sheath of the transplanted tendon, while on the external surface of the graft, where the sheath was absent, it was slight. In one or two cases the condition described by Goldthwaite, in which part of the pull of the muscle is absorbed by the fibrous band formed in the old sheath, was illustrated.

Before the thirtieth day the strength of the graft depended entirely upon the strength of the callus surrounding it, adhesions between the portions of the tendons in direct contact, even if they could have been demonstrated microscopically, being too slight to be of practical importance. Since union between these portions is so slow to begin and lasts so long (Hoffa found changes still going on after 242 days), the conclusion seems justified that the stability of the graft depends upon the formation of a good callus and that the change which goes on in the interior of the callus for so long a time is not of great practical importance. The chief requirement is that the tendons be sutured firmly enough to maintain approximation until this callus forms; that in suturing them firmly there is any especial danger of producing sufficient necrosis to cause the suture to yield, I do not believe.

The occurrence of separation in 3 cases of the last series suggests that this plays a more important part in failure, and that greater care should be taken to obtain a sufficient hold on the tendon. Experiments made as to the strength of the different methods of suture are too few to be reported in detail at this time. Lange's method seems to offer the greatest strength. Out of 3 cases in which the divided tendo Achillis was sutured by his method and the rabbits allowed the unrestricted use of the part, the suture held in 2, while in 2 cases in which Suter's method, which seemed to promise a firm hold, was used, the suture pulled out in both. Lange's method combined with the buttonhole method would seem to offer the greatest strength.

CONCLUSIONS.—1. Yielding of the tendon in tendon suture and transplantation through necrosis produced by over-tight sutures must occur, if at all very rarely, when the sutures are tied under ordinary tension.

2. Failure of the suture through insufficient hold is, however, probably fairly common.

3. The process of repair is slower in tendon transplantation than in tendon suture and tenotomy, the probable cause being:—(1) Interference with the circulation of the reinforcing tendon due to its separation from the surrounding tissue for so large a portion of its length, and (2) defects in the synovial sheath. Care should be taken, therefore, not to separate the tendon from the surrounding tissue for any greater distance than is absolutely necessary and to preserve and suture the sheath as far as possible.

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III.

A CASE OF SCOLIOSIS CAUSED BY INJURY OF ABDOMINAL MUSCLES.

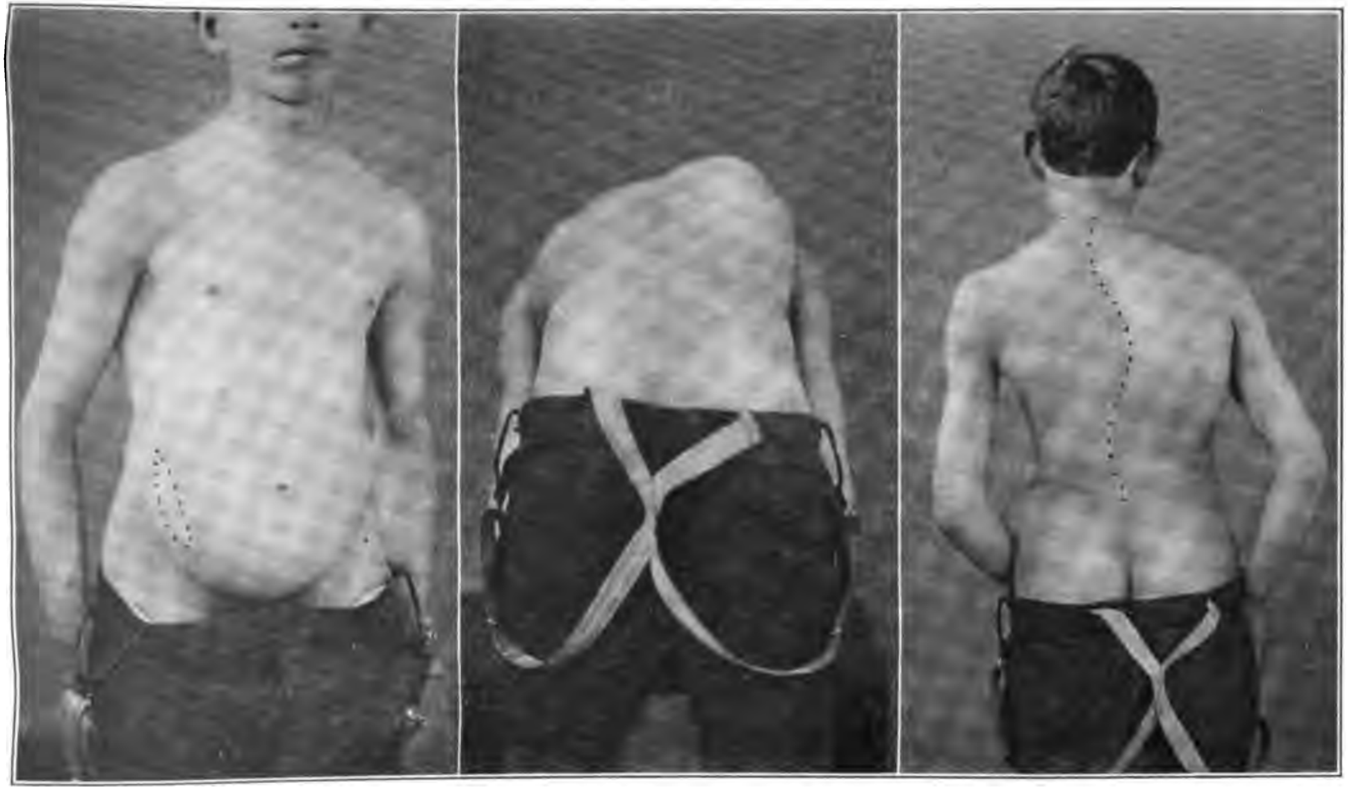
EDWIN W. RYERSON, M.D., CHICAGO, ILL.

Compton Riely and R. T. Taylor have suggested that a lack of balance of the abdominal muscles may be a cause of scoliosis. A case seen recently at the orthopedic clinic of the Rush Medical College Dispensary seems to show this so clearly that it is here reported.

John E., a boy of sixteen, has been unusually well and strong all his life. No spinal deformity has ever been noticed in his early years. At the age of thirteen and one-half he slipped and fell on an icy sidewalk. A long, sharp knife which he carried in his coat pocket penetrated his abdominal wall at McBurney's point. A laparotomy was performed within twelve hours, and several intestinal wounds were sutured. The incision was drained for four weeks and he finally recovered. Whether or not a fecal fistula existed cannot be learned. About a year after his accident it was noticed that his back was crooked, and one shoulder was higher than the other. No physician was consulted for nearly a year, when the deformity had become pronounced.

He appeared at the clinic in April, 1906, a strong, healthy boy who looks older than he is. A white scar, five inches long and one inch wide, extends downward parallel with Poupart's ligament, from two inches above the anterior superior spine of the right ilium. There is no hernia of the abdominal wall, although a distinct furrow can be felt. Sensation is unaffected above and below the scar. The lower costal border is not as close to the pelvis as on the other side, by about an inch.

A very marked right dorsal scoliosis exists, with a high degree of rotation. There is a small compensatory curve to the left in both lumbar and cervical regions. The photographs fail to show clearly anything but the rotation. The boy was at once



A Case of Scoliosis due to Injury of Abdominal Muscles.

placed in the lateral curvature class, which he has faithfully attended for three months. The deformity, however, has continued to increase.

It may be claimed, with some probability, that the scoliosis is not due to the abdominal inequality, since so many children show precisely similar curvatures with no such muscular pathology, but to me the abdominal etiology is so suggestive that unless there is evidence of improvement before long, I shall excise the scar and shorten the transversalis and the internal oblique.

These two muscles would seem to be the chief offenders, since the incision and scar are parallel to the fibers of the external oblique.

IV.

A NEW FORM OF SHOEMAKER'S LAST.

Being a further extension of the usefulness of plaster-of-Paris, enabling the orthopedic surgeon, in a measure, to escape from the thraldom of his shoemaker.

ANSEL G. COOK, M. D.

Civilized man is compelled by his environment to do something for the protection of his feet, consequently, he wears shoes.

Satisfactory shoes are not easily obtained, and people are always trying to get better ones.

Orthopedic surgeons and shoemakers are constantly inventing new shapes of shoes which they call perfect, and insist that everyone should wear, forgetting there are many kinds of feet, and that no one style of shoe can possibly fit everybody.

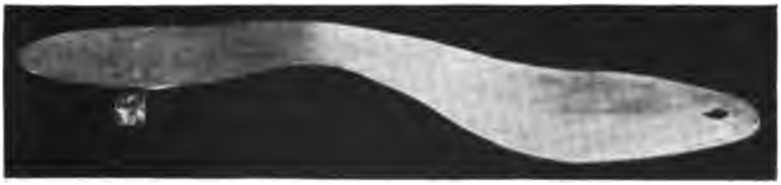


FIG. I. Steel Foot-piece. (Side view.)

Custom shoemakers make special shoes for special feet. They are more or less influenced by the advice of orthopedic surgeons, but are inclined to listen with a polite tolerance, and then carry out their own ideas. Even when they do listen, wooden lasts are extremely difficult to make, and the best shoemakers make many misfits.

It is not the province of this paper to exploit a new form of shoe, nor even suggest what form of shoe is best adapted to general use or for special conditions, but to point out a way by which the orthopedic surgeon can obtain any kind of shoe he wishes and have it fit.

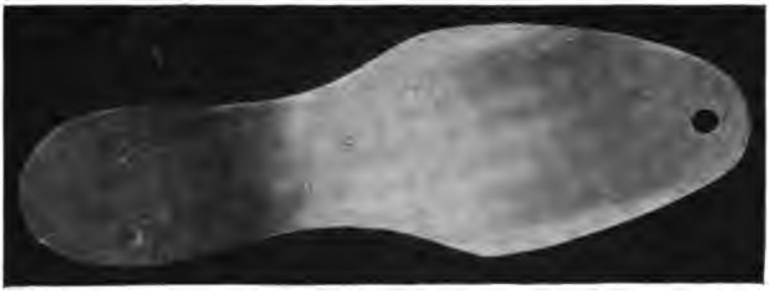


FIG. 2. Steel Foot-piece.

Having for years tried the various ready-made shoes on the market, as well as the shoes made on wooden lasts by custom shoemakers, sometimes with success or partial success, often with disappointment, and always with uncertainty, it finally

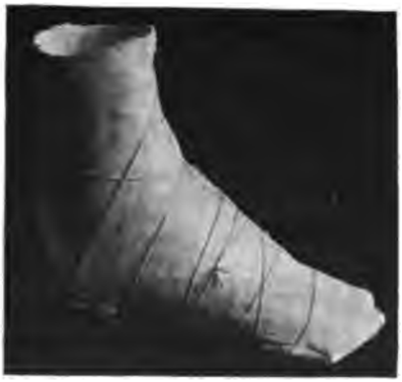


FIG. 3. Mold of Foot.

occurred to me to make shoes over plaster-of-Paris casts of the feet on which they were intended to be worn.

The idea was neither new nor original. The first man who made a plaster cast, probably thought it would be a good model on which to make a shoe.

Orthopedic surgeons and shoemakers often make plaster-of-Paris casts of the feet, but they do not make shoes over them, but use them, if at all, as models from which to make their wooden lasts—the shoemakers at least believing that casts are of little use, except to impress the patient.

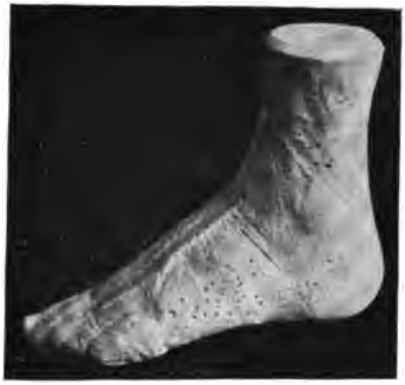


FIG. 4. Rough Cast just taken from Mold.

The objections raised by the shoemakers are:—

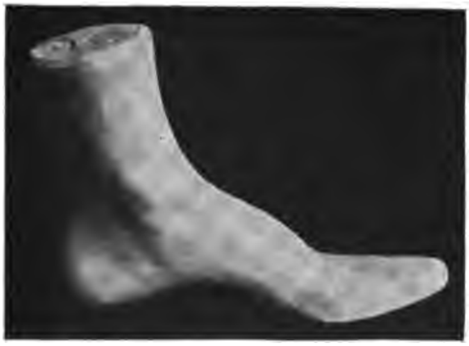


FIG. 5. Cast scraped and Toe added.

First.—That a plaster-of-Paris cast of the foot bears no resemblance to a shoemaker's last, and that a shoe made over it would not look like a shoe.

Second.—That shoemakers must necessarily hammer the leather on their lasts, and a plaster-of-Paris cast cannot be hammered.

Third.—That if a shoe is made over a plaster-of-Paris cast, it cannot be taken off the cast after it is done.

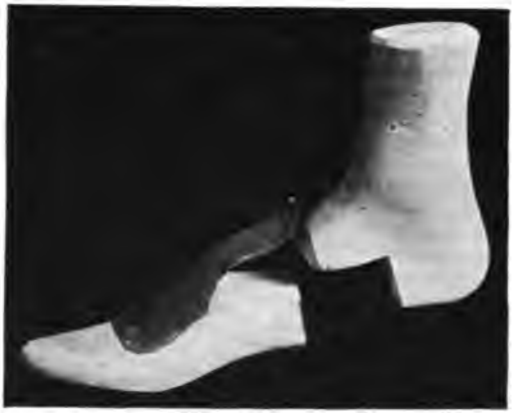


FIG. 6. Cast sawed in two and converted into a Shoemaker's Last.

So far as I know my own are the only serviceable shoes ever made over plaster-of-Paris lasts.

The first step in making these lasts is to obtain a plaster-of-Paris model of the foot.

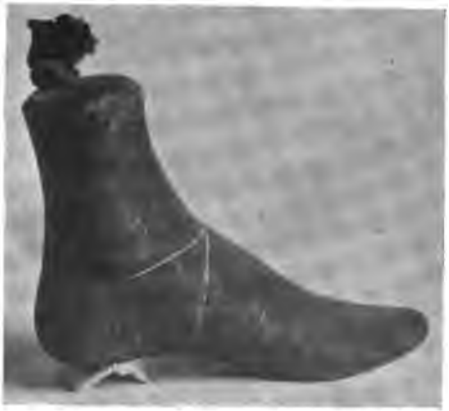


FIG. 7. Last Covered with Stocking and ready for Use.

~~To do this~~ # seat the patient in a comfortable chair, the foot hanging down, and the muscles relaxed. Then completely cover the foot with a thin layer of vaseline and place a small strip of lead over its dorsal surface. Now, apply a plaster-of-Paris bandage, incorporating in the last few turns of bandage, a steel plate, cut in the form of the sole and heel of an ordinary shoe.

Place the foot on the floor with the foot flexed to a right angle, and carefully mold and rub in the plaster-of-Paris bandage until it has set.

To remove the cast, cut down over the piece of lead, spring the cut edges a little, and pull off as you would a boot.

After removing the cast, approximate the cut edges, tie with string or a bandage, and it is ready to fill with plaster-of-Paris cream.

When the plaster-of-Paris has thoroughly set, the original mold, including the steel foot-piece is stripped off leaving a perfect model of the foot, in the position it assumes when an ordinary shoe is worn.

To make the last complete, it is only necessary to add a graceful toe, which can be easily built on with a little practice.

Finally, saw the last in two at the instep, making a shoulder to prevent slipping. Tack on a small piece of leather to steady it, and cover the last with a stocking. The shoe is now lasted and bottomed in the usual manner.

To remove the last, pull the heel-piece out of the stocking. Then pull out the stocking, and you have the toe-piece.

The heel is put on after the shoe is taken from the last. #

V.

ON COXA VALGA.

DR. B. GALEAZZI, MILAN, ITALY.

Although recent clinical researches have confirmed us in our opinion that the anomalies in the direction of the femoral neck are but the anatomical result of affections of different nature, we are yet far from a thorough knowledge of their origin and mechanism.

Though the pathology of the coxa vara, so much studied in its fundamental principles by E. Müller, Hofmeister, Kocher, etc., is better known than all the other varieties of the deviation of a normal femoral neck, we cannot say that such researches should not be continued; because a pathogenic, anatomical and pathological distinction between the static coxa vara and the identical modification of the neck of arthritis deformans has not yet been established with certainty.

The affirmation is perfectly true with regard to coxa valga, a morbid form yet little known, but the existence of which, though, is no more to be doubted through a few observations.

The bibliography of the anomaly of the femoral neck is briefly traced.

Leaving aside the cases of coxa valga of traumatic origin, in which the abnormal direction of the neck had its origin in a deformed callus caused by antecedent fracture (Thiem, V. Bruns, König, Hoffa), the most interesting series of observations on coxa valga is given by Albert, who has met it in various pathological states of the leg among the anatomical specimens in the Museum of Vienna (paralysis in children, rickets, osteomalacia, pelvic osteomyelitis, multiple exostosis, genu valgum, congenital dislocation of the hip-joint). Besides one case of congenital, bilateral coxa valga recently described by David, we find, in clinics, a tendency to the increasing of the size of the femoral angle in the congenital dislocation (Luning-Schultess, Schede) and in amputated stumps (Lauenstein). Lastly we have clinical observations on coxa valga, so-called primitive, by Hofmeister and by Manz, whose diagnosis, though, was founded on so uncertain and irrational a symptomatology (Manz) that makes one greatly doubt as to its accuracy.

Till now a case of valga in the neck, not accompanied by lesions in the leg to which this cervical anomaly pertains (paralysis, inactivity, congenital dislocation) and aided by the X-rays, has not yet been published.

The causes of the lack of bibliography on the hip distortion are attributable to the rare cases of the affection and its limited practical importance, because it is considered by most as a simple anatomical abnormal state, deprived of important clinical manifestations.

Through my researches, though, I am inclined to come to different conclusions.

In the first place the methodical measure of the femoral neck, obtained from a large number of young persons by means of the X-rays, leads me to conclude that the physiological oscillations in the femoral angle are comparatively greater than those established by Hoffa.

In perfectly normal individuals I observed that the angle of direction of Alsberg amounted from 53 to 55 degrees and even to 58 degrees without any anomaly of gait in walking, nor any functional troubles.

According to my researches there still exists a certain degree of physiological coxa valga, which I believe to be connected with an abnormal disposition, probably congenital, of the upper epiphysial line of the femur.

I have observed that the normal direction of this upper epiphysial cartilage of the femur, is normally marked by a parallel line to that which marks the normal aperture of the cotyloid cavity and it is evident that, in case of the normal growth of the epiphysial lines, the angle of the direction of the neck must vary according to the inclination of this epiphysial line.

In all the cases in which there existed a certain degree of coxa valga, the epiphysial line formed a more or less visible angle with the aperture of the cotyloid cavity.

We find an evident proof in the X-ray examinations which illustrate the case of congenital coxa valga published by David; we see that the line made by the interepiphysial cartilage is almost normal to the line of the cotyloid cavity.

I have also repeatedly confirmed what the anatomical researches of Albert and of Turner, and the clinical observations of Lauenstein had shown, namely, that the etiology of coxa valga resides very often in all those moments in which the weight of the body is taken from the femoral head or exercises a traction in the inferior extremity, as do the powerless legs of paralytics.

But I have also observed that there are special conditions in the functions of the hip-joint during the period of growth, which, independently from the momentary taking the weight off and hanging of the leg, can cause an exaggerated size in the femoral angle; as, for example, when the muscular equilibrium is disturbed by the coxa femoral articulation in its functions with the bones that form it, pelvis and femur, singular static conditions of pressure and of traction may be created in the latter, such as may modify the inclination of the cervical angle, causing a coxa valga that I should call a functional one.

To confirm what I have just stated, I give the X-ray examination of the left hip-joint of a young paralytic, who had always walked leaning on it, and in which a very severe psoas existed, while the outer muscles of the hip-joint were almost completely paralyzed. (Fig. 1.)

Now it seems to me that in this case the mechanism of the production of coxa valga can be evidently explained, if we consider the conditions under which the person walked normally.

At every step the sound muscular part of the psoas became greatly contracted, exercising a powerful traction over the small trochanter; and we have anatomical proofs in the abnormal development assumed by this protuberance, clearly shown by the X-ray examination; while both the trunk and the pelvis, on account of the weakness of the outer muscles of the hip-joint and on account of the complicated subluxation of the hip-joint, inclined laterally and backward, exercising reversed pressure and tractions over the head and neck of the femur. And the persisting of these reversed influences for a long period of time on the upper extremity of the femur when growing, clearly explains the acute degree of valga, which can be met with in that patient.

The systematic measuring of the cervical angle, which was, of course, made with all necessary cautions to avoid errors, has permitted me to gather a certain number of cases, in which, having one of the legs, for a long period of time, been in exaggerated adduction on account of various diseases of the hip-joint, for which reason the other leg had been kept by the obliquity of the pelvis in a permanent position of abduction, a certain degree of valga had been produced, measuring even from 140 degrees to 145

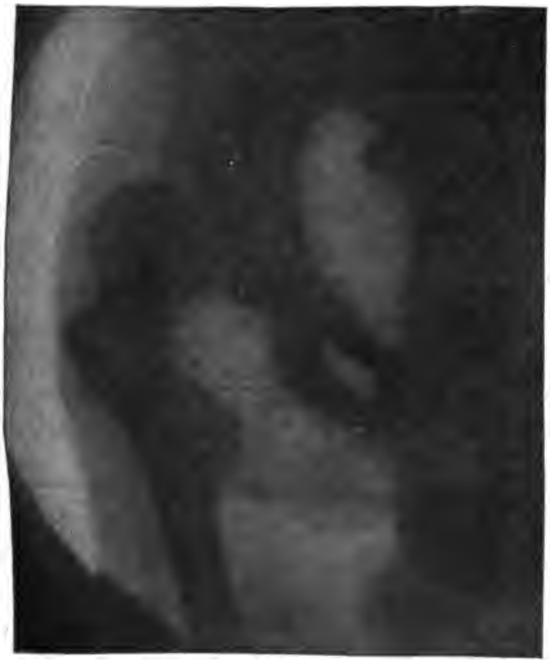


FIG. 1.

degrees, the angle of Mikulicz, and from 50 degrees to 55 degrees, the angle of Alsberg.

Besides this functional coxa valga attributable to different pathological states of the leg, or of the pelvis, we undoubtedly have cases of coxa valga, the pathogenesis of which is very obscure, there lacking any other morbid manifestations.

In less than two months I have been able to make two characteristic observations of such a lesion, which, being the first that are published with corresponding X-ray examinations and illustrations, and having been cured by rational and successful surgical process, seem to me worthy of special notice.

The first observation was made in a healthy girl, aged 12 (E.B.), without any preceding rickets; the girl's family were poor and there consequently was deficiency of food and hygiene. The date of the first manifestations of the functional alterations was well noticed both by the patient and the family; we can, therefore, fix with certainty the development of the deformity in a period of two years.

Its origin cannot be attributed to any known cause, there not being traumatism, rheumatism or infection.

The abstract manifestations in this case were limited to pains in the articulation of the left hip-joint, more severely felt in the inner part, to getting easily tired and to limited movements of the joint.

The functional examination showed a characteristic gait in walking in the girl, besides her evident lameness, namely, a marked obliquity backwards and forwards and from left to right of the trunk, obliquity which only disappeared when the patient walked with her left leg making an exaggerated outer rotation.

In an erect posture and with her legs parallel the pelvis appeared oblique, so that the front and upper anterior spine appeared in a front and lower plane compared to the right one (Fig. 2), while a convex static scoliosis towards the right and a slight exaggeration of the physiological lumbar lordosis were to be noticed.

A slight genu valgum was also observable.

When at rest the girl slightly bent her left leg, assuming the posture of a person who stands on the right leg.

The outlines of the hip-joints showed a remarkable difference between the upper part of the left hip-joint and the right one, and the former having lost its normal convexity appeared flat, as will be clearly seen by the photograph.

On asking the patient to keep an erect posture, resting only on her left leg, a characteristic phenomenon took place, a marked inclination of the pelvis and of the trunk to the side on which she leaned; this symptom, contrary to the phenomenon of Trendelenberg, is evidently reproduced by the photograph (Fig. 3).

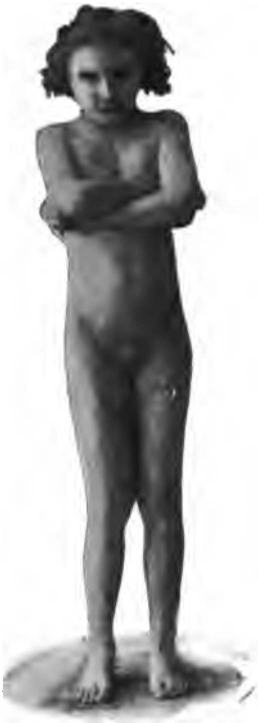


Fig. 2.

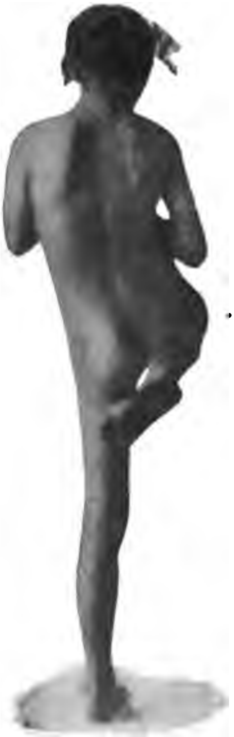


Fig. 3.

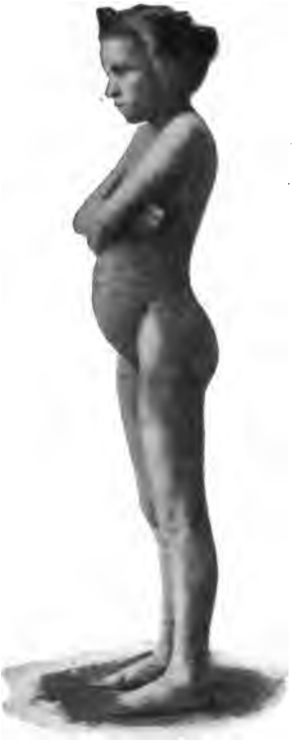


Fig. 4.

In dorsal decubitus and with the legs parallel, the anterior spine measured different distances from the plane of the bed (12½ cm. to the left and 11 cm. to the right) and this difference became more marked when attempting to correct the outer rotation of the leg.

The distance from the front upper anterior spine to the inner malleolus was of 2 cm. greater to the left than to the right.

The movement of passive flexion was normally made, while that of abduction went further than the normal limits, as to make with the median line of the trunk an angle of 75 degrees, while the movements of adduction and of inner rotation were, so to say, abolished.

The great trochanter could be palpated only with great difficulty and was found at 2 cm. below the line of Roser-Nelaton, so that the vertical line of the triangle of Bryant measured 10 cm. to the left, while the one to the right measured hardly 8 cm. (Fig. 4.)

The X-ray illustration of the upper extremity of the femur is greatly demonstrative; it is the expression of the valga at its highest degree, for the femoral neck was the continuation in a vertical line of the diaphysis, which seemed to assume a certain roundness at the superior extremity to form the femoral head (Fig. 5).

The latter, although of normal proportions, was, on acount of its abnormal direction, in contact only with the high part of the cotyloid with its inner half.

In no points of the upper end of the femur were there traces of antecedent fractures and the articular surfaces appeared smooth and regular.

I made the second observation in a young girl, aged 13 (U. G.), in whose case rickets is excluded by anamnestic signs, accurately noticed both by the family and by the attending doctor, as well as by the absence of objective notes.

Differing from the preceding case it seems that in this patient the gait in walking was rather imperfect since she began to walk; yet real lameness was only noticed four or five months before the onset of the disease, acute pain occurring at the same time in the left hip, and the pain was more acutely felt when the patient began to walk after a rest.

In this patient the visible symptoms were more pronounced than in the first; greater oscillation of the trunk, so that the girl walked with her leg in abduction and with a slight flexion while the trunk was much inclined to that side, when she leaned on the deformed hip.

The habitual outer rotation appeared more exaggerated as well as the convex scoliosis to the left side.

The difference of length of the legs was of 1½ cm. and of 1 cm.; the greater trochanter on the line of Roser-Nelaton was also lowered, as well as the outer outline of the right hip evidently appeared on a level.

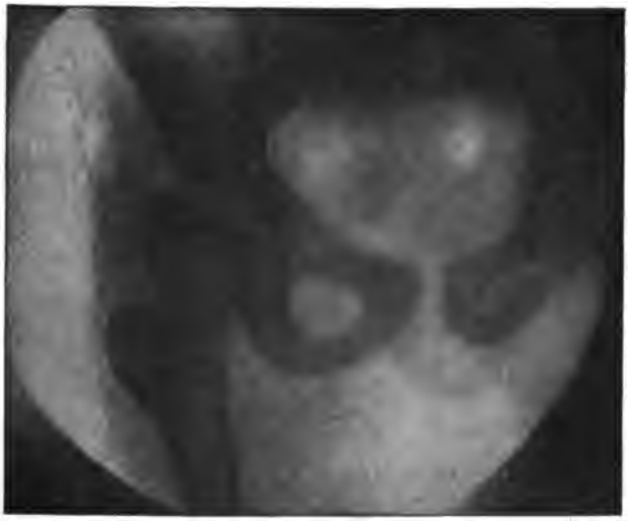


FIG. 5. First observation before operation.

In the above case a certain degree of atrophy in the gluteii muscles of the hip was noticed; the only movement that was limited was that of the adduction.

The photograph, obtained with the X-ray, is not less evident in this case as in the preceding one.

If the deformity was less pronounced, there was an alteration in the shape of the femoral head, which had lost its roundness, resembling a fungus; a large part of it was, moreover, out of the cotyloid cavity (Fig. 7), so that the weight of the trunk was no more transmitted from the pelvis to the highest part of the head, but to a declivitous portion of the sphere, and this explains the unsteady, almost luxating gait of the patient in walking.

These two observations greatly contribute to the study of coxa valga, because they have given me the opportunity of pointing out some manifestations of this anomaly, which will delineate its anatomopathological physiognomy and its clinical table.

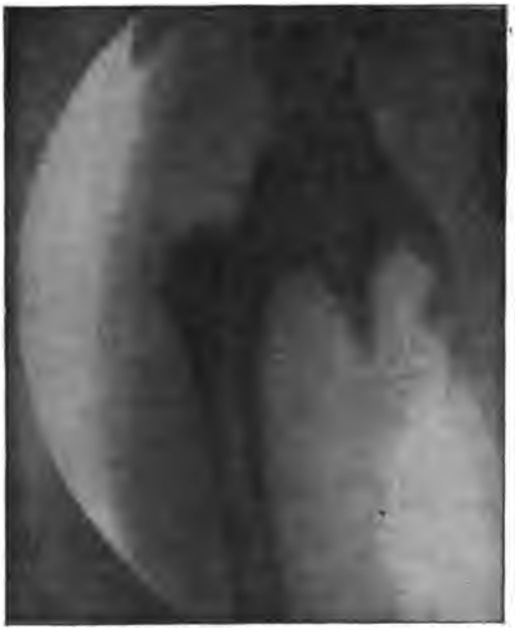


FIG. 6. First observation after operation.

The etiology in both cases is yet obscure and I do not possess any elements to suggest a founded hypothesis.

In neither of the patients there existed any signs of infantile or tardy rickets, and although the lack of visible traces does not permit us to exclude, in a positive manner, the existence of a slight form of rickets during infancy, it would not be a well reasoned hypothesis saying that the alterations of the skeleton should have only left, as a manifestation, the lesion of the upper extremity of one of the hip-joints—because the slight degree of genu valgum, observable in one of the patients, the first described, is to be interpreted as a static form, considering also its recent onset.

It also seems difficult to me to explain the mechanism by which a process of rickets might produce a coxa valga, while the genesis of the opposite deformity is so frequent and rational. I believe that we cannot consider coxa valga as a static deformity; in fact I could not find a similar example in the numerous cases of children affected by rickets who are under my treatment.

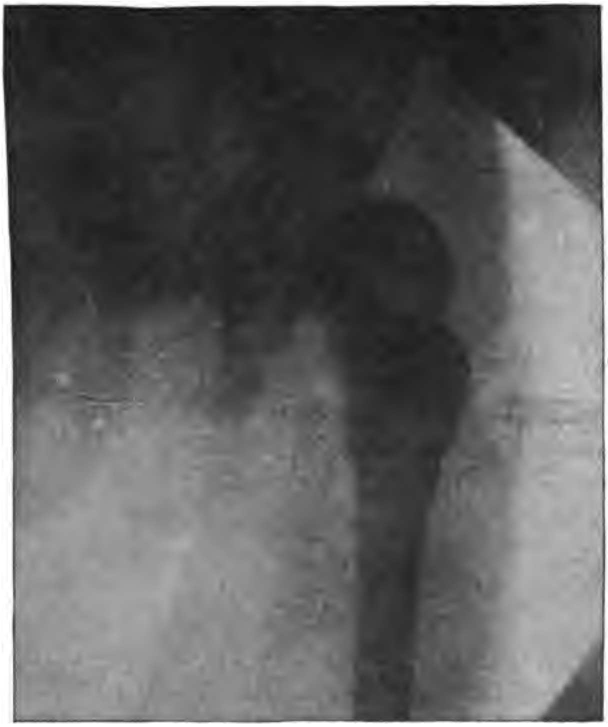


FIG. 7. Second observation before operation.

Besides, the demonstration of this etiology admitted by the authors, according to the affirmations of Albert, is not yet a proved fact, because, of the two photographs of anatomical specimens given by this author, only one presents a deformity of the whole femoral head with a real coxa valga.

In the cases of Lauenstein and of Hofmeister in which the cause of the deformity was attributable to antecedent rickets during infancy, the lack of the X-ray examination does not give us a sure evidence about the direction and shape of the neck and about the character of the anomaly.

In the first of my observations the X-ray examination of the hip-joint of the opposite side showed a curvature, a real twisting of the femoral neck with convexity turned upward, so that we might suppose a static alteration of the hip-joint of the opposite side; in the other case the upper extremity of the femur of the opposite side appeared perfectly normal; so that also in this case etiology is wrapped in obscurity, unless we give some weight to the evident alteration in the shape of the head; thus approaching the nature of this alteration to that of arthritis deformans of the hip-joint, of which there were no symptoms, though.

The absence of any constitutional disease or lesion of the muscular or nervous apparatus of the skeleton, might lead to the belief of a congenital malformation, especially in the second case in which the abnormal way of walking was noticed when the child first began to walk; against this hypothesis arises the unilateral lesion.

The clinical experience I continually make of lesions of the hip, would induce me to admit that this part of the human body, having so important and difficult a function, must necessarily be subjected to different disorders in the process of osteology, till now unknown to us, but of which we often have, in our clinic, evident manifestations, be it under the form of pains in the hip, very frequent in adolescents, be it in the similar contractions of real coxalgies, which even the most skilful physicians often misunderstand.

According to my opinion I insist upon the hypothesis that these anomalies in the shape and direction of the femoral neck have their origin in functional disorders in the process of osteology of the femoral head.

If we examine, from objective symptoms, the most important clinical manifestations, a complete and characteristic table is set forth, as was not described till now.

Besides the pathognomonic symptoms observed by Hofmeister and by Manz, who were the first to describe the deformity, namely, the position of abduction and of outer rotation of the leg, the limited movements in the opposite direction, I have been enabled to ascertain the existence of the following symptoms, which are greatly important, having been noticed in both observations.

Firstly, the presence of the pains in the region of the hip-joint, which increased after prolonged rest and which disappeared during dorsal decubitus; secondly, a real lengthening of the leg of from 1½ to 2 cm.; a plane of the normal outline of the hip-joint, due to a deeper position of the great trochanter and the seat of the apex of this tuberosity below the line of Roser-Nelaton.

At last are worthy of notice the characteristic gait in walking due to the obliquity of the trunk and the outer rotation of the leg and the alteration in the mechanism of the hip-joint, rendered visible by numerous signs, especially the abnormal and exaggerated inclination of the trunk towards the side of the coxa valga, when the patient leans only on the leg of that side.

Evidently the causes of the last manifestations must be various; I believe that it is principally caused by the necessity of equilibrium on account of the abduction of the leg and the abnormal shape of the upper extremity of the femur; with this instinctive inclination of the trunk, the result is that the axis of gravity must pass through the leg on which the person leans.

From the above described clinical observations on coxa valga, two certain facts result:

1. A greater frequency of cases than it has been supposed till now; because, although the patients of the Hospital for the Crippled in Milan are exceptionably numerous, the two classic and demonstrative cases which I had to deal with in less than two months, lead me to believe that the methodical study of all the patients who complain of functional trouble in the hip-joints, the number of observations on the coxa valga will increase, with the help of the X-ray examination.

2. The lack of foundation in the almost unanimous opinion of the authors, that this be an anatomical anomaly without any practical importance for clinical experience; in both the cases studied by me the functional troubles caused by the deformity were far from insignificant and showed a clear character of progression, which demanded the aid of a surgical operation.

Before now nothing had been attempted to cure the troubles caused by such a deformity.

David has tried to ameliorate the static conditions of the legs in the case of congenital bilateral coxa valga which he described, keeping the hip-joints of the patient immovable for six weeks in plaster-bandages in an inner rotation and exaggerated adduction. But I fear that this method has not given lasting and satisfactory results.

In my two serious cases I could not hope of obtaining any good result, except by modifying the anatomical form of the femoral head, and it is exactly what I have done, reconstricting the normal form of the upper extremity of the femur. Being convinced that in all the anomalies of the direction of the neck the part to be operated must be the basis of the neck and not the under trochanteric region, and wishing to avail myself of the strength represented by the great muscular masses that are to be found over the great trochanter, to pull it upwards, I have, in both cases, practised osteotomy under the periosteum of the femoral neck in the spot of insertion in the shaft.

This was done by a straight cut, made with a vertical incision 10 cm. long, between the sartorius and the fascialate; the first time with the convex osteotome of Codivilla, the second time with an ordinary chisel.

When the wound was completely sutured I have applied a slight traction to the leg to prevent a great displacement of the fragments, without preventing the slow and gradual ascending of the great trochanter.

The process of recovery was in both cases feverless and regular; after the operation I have followed step by step, taking X-ray photographs, the ascending of the great trochanter by means of the pelvic-trochanteric muscles, which I have stopped at the proper moment by a plaster-bandage, in which I made the patients walk on the fifteenth and twentieth days.

By this simple operation I have obtained perfect recovery in both cases, and not only anatomical recovery but also functional. The radiographs of the hip-joints after the operation (Figs. 6, 8) will show the successful result obtained. In the first case the callus is not perfectly regular; in the second patient the only trace of the osseous section there is a slight fusiform enlargement of the basis of the neck.

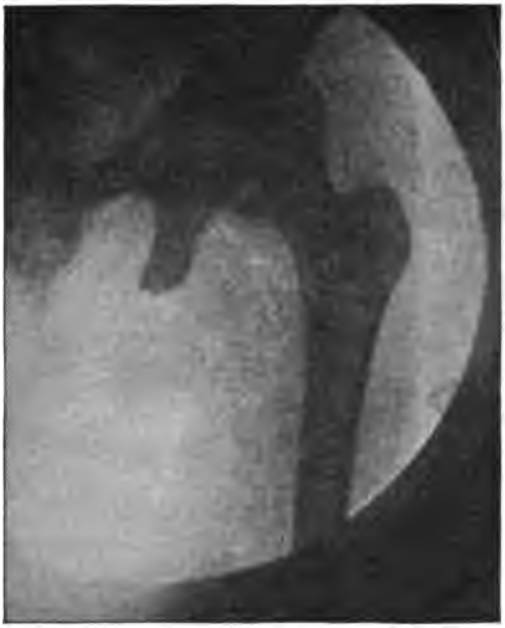


FIG. 8. Second observation after operation.

From the diagrams reproduced in the Figures 9 and 10 any one can see how the femoral angle has become normal in both cases.

In the first the angle of inclination from 160 degrees descended to 130 degrees, and in the second from 169 degrees to 130 degrees; the angle of Alsberg had the following modifications:

1, from 67 degrees to 47 degrees.

2, from 94 degrees to 40 degrees.

Osteotomy having been completely extra-articular, the hip-joints maintained their perfect mobility and the gait in walking

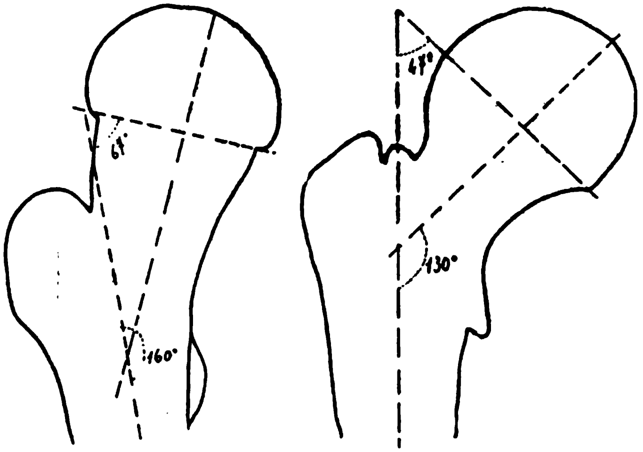


FIG. 9.

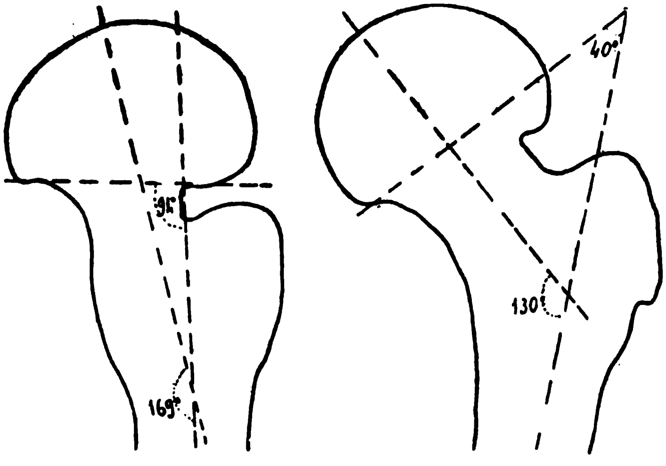


FIG. 10.

of both girls became normal again and is still unaltered after a year since the operation was performed.

This successful result makes me not only believe that the method

I followed is the most rational to correct this anomaly of the femoral neck, but is also that by which I have obtained the cure of coxa valga in many other cases, thus convincing me once again that osteotomy at the basis of the neck is the most rational means of correcting all defects of the inclination and of the form of the femoral neck.

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Milan, 30 Marz, 1906.

VI.

COXA VALGA OR COLLUM VALGUM.

BY DR. JAMES K. YOUNG.

Since Müller first called attention to coxa vara it has been carefully studied in all its various phases, but the opposite condition, coxa valga, has received but little notice, and a few authors only have written upon the subject.

Coxa vara is considered as a serious clinical disease, but coxa valga is simply described as an anatomical or pathological change in the direction of the neck of the femur.

The modern text-books do not even mention the subject, describe it superficially, or include it as a form of coxa vara, so that the medical profession in general are not familiar with the symptoms, and in some instances are not even aware of the existence of this deformity.

Under these circumstances it seems not unsuitable to present the following cases which have come under my own personal observation.

Coxa Valga from Traumatism.—Probably Fracture of Neck of Femur.

Case 1.—D. D. An Italian boy, eight years of age, with family history free from any hereditary taint, was brought to me for examination January, 1906, by Dr. M. A. Roberts. About five years ago the child fell, after which the mother noticed that he walked "crooked." The deformity has been increasing of late. When he falls down he has difficulty in getting up.

Examination of patient revealed the following condition:

Patient stands on left leg with right knee thrown forward and inward, the lumbar spine curved, with the convexity to the right, and with the left shoulder depressed. In walking he limps on the right leg. In standing the creases of the buttocks are inclined to the left, and the abdomen is pendulous and prominent. In the lying position there is slight lordosis and the pelvis is tilted upward on the right side. The right leg is apparently longer than the left, although the bony measurements are the same. In the right hip flexion is abnormal, the thigh is carried outward in abduction during flexion, and adduction is then limited. In the left hip all movements are normal. The right limb is adducted upon the pelvis. Flexion of both knees shows the femur of the right to be a little longer than that of the left, and the lordosis is not entirely lost until both thighs are flexed upon the abdomen. The spine is flexible in every direction, and there is no osteitis present.

Skiagraph shows angle of neck of femur on right side to be decreased to about 142°, while on the left it is 132°.

On the right side the angle of depression is 142°.

On the right side the angle of elevation is 48°.

On the left side the angle of depression is 136°.

On the left side the angle of elevation is 36°.

I divided the adductors from their pelvic attachment, encased the leg in plaster, and abducted the limb for two weeks.

Coxa Valga from Forceps Delivery.

CASE 2.—P. R. A girl, aged four years, with a family history of cancer and tuberculosis.

Mother a primipara, rachitic and delicate; child born by breech presentation after long and difficult labor.

Forceps were applied to breech until traction could be made on feet. No traction was made on head.

Child was weak in infancy. Had whooping cough when four months old, which lasted until ten months old. Child never crept nor attempted to hitch herself along the floor; during past two weeks (is now four years old) has attempted to stand but not alone.

Present Condition.—Child small and delicate looking. Poor muscular development. Teeth fair. Mental development normal. Does not sit up well and prefers to lie down. Mother has noticed that the child is left-handed, and right arm seems slightly spastic, and has slight wrist-drop; grasp weaker.

Both lower limbs stiff; feet held in equinus position; patellar reflex delayed and exaggerated; limbs poorly developed.

Stands when supported in position of equinus with knee flexed and right foot advanced.

Length of spines to malleolus. Right 16½″, left 16¼″. Bryant's triangle destroyed on right side. Trochanter posterior and 1 cm. below Nelaton's line.

Limbs held in adducted position; can be only slightly separated. Abduction very limited with spasm of adductors noticeable. Internal rotation possible on left side, but very slightly so on right.

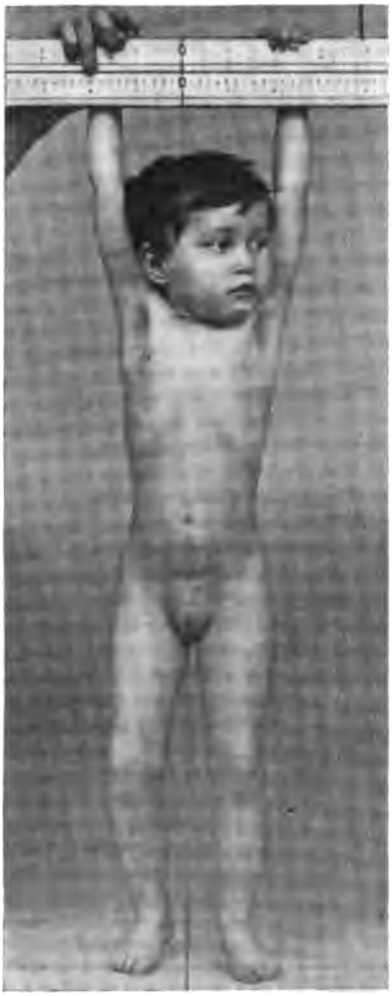

Fig. 1. Case 2. Coxa valga from forceps delivery. Front view.

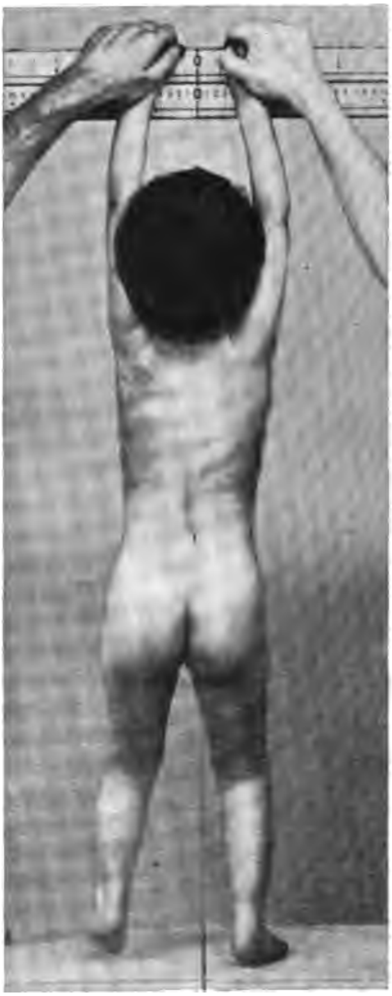

Fig. 2. Case 2. Coxa valga from forceps delivery. Back view.

Flexion of thigh on pelvis difficult. Outline of thigh and hips abnormal on both sides.

Skiagraph shows coxa valga on both sides, more marked on right; and also shows marked backward displacement of trochanter on right.

On the right side the angle of depression is 174°.
On the right side the angle of elevation is 86°.
On the left side the angle of depression is 164°.
On the left side the angle of elevation is 79°.

Coxa Valga from Separation of the Epiphysis.

CASE 3.—A. R. A Russian boy, four years old, with a negative family history, was admitted to the Polyclinic Hospital, February 6, 1906.

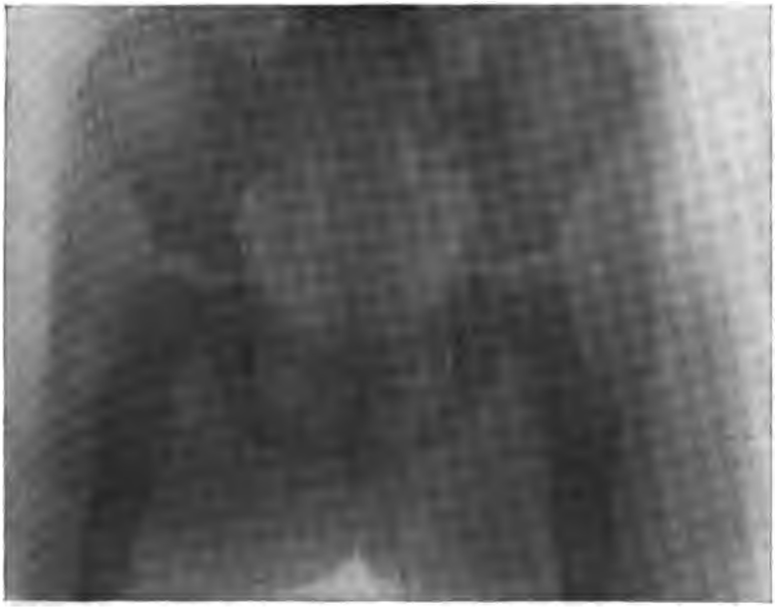

FIG. 3. X-ray photo of Case 2. Coxa valga from forceps delivery, showing extreme angle of depression.

Two years before admission, while robust and in perfect health, the child fell. Complained of severe pain in right hip, which was worse at night, but continued to walk with decided limp for one week.

Examination revealed the following conditions:—

The right leg is shortened one inch. There is fullness about the right trochanter. There is no abduction.

An X-ray photograph showed a separation of the head and epiphysis of the femur on the right side.

Bed traction of five pounds was applied, the limb being in an abducted position in order to avoid coxa vara.

He was discharged cured four weeks from the time of injury. On May 6, he was readmitted on account of stiffness in the right leg which is more prominent in moving on rising. He limps slightly in walking, more noticeably when tired. The pain is not referred to the knee. Cannot lie on the right side, but sleeps well. His general condition remained good.

Examination at this time showed the clinical symptoms of coxa valga, which was confirmed by the X-ray.

On the right side the angle of depression is 144°.
On the right side the angle of elevation is 58°.
On the left side the angle of depression is 133°.
On the left side the angle of elevation is 33°.

Coxa Valga from Knee-joint Disease.

Case 4.—M. B. A boy, two and one-half years old, of German extraction, was referred to me by Dr. W. D. McConaghy in March (30), 1904.

There was no family history of rickets or tuberculosis, and he was well and strong until February, 1903, when he sustained a slight traumatism of the left knee and hip.

Extension was applied for three months, followed by a cast to the knee-joint. While wearing this cast (October, 1903) an abscess formed and a superficial sequestrum was removed from the outer condyle of the femur which contained tubercle bacilli. Upon the healing of the sinus (January 10, 1904) he was allowed to walk. The biceps tendon began to contract at this time, and it was for this he sought advice.

Examination showed an ankylosis of the left knee-joint from tubercular arthritis complicated by the clinical symptoms of coxa valga. The affected limb was half an inch longer. This diagnosis was confirmed by the X-ray.

On the right side the angle of depression is 130°.
On the right side the angle of elevation is 42°.
On the left side the angle of depression is 160°.
On the left side the angle of elevation is 68°.

I divided the biceps tendon, and equalized the limbs by a sole on the sound side. The leg became one-fourth of an inch shorter.

Coxa Valga from Rickets.

CASE 5.—L. Z. A Russian boy, four years of age, was admitted to the Polyclinic Hospital, April 13, 1906. Family history was negative as regards any hereditary taint bearing upon the present condition.

Present History.—Mother noticed peculiarity in child's walk about two months ago, child becoming rather shuffling in his walk; the right leg apparently being affected. Condition has been getting worse.

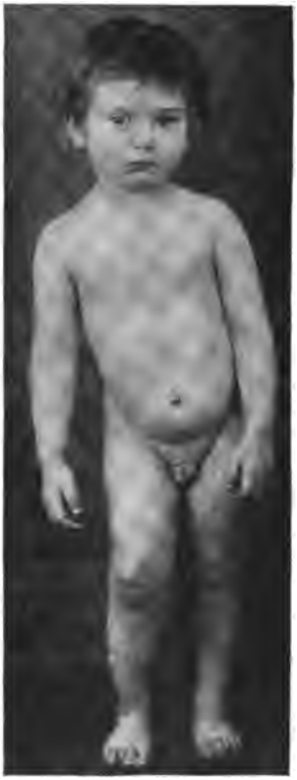

FIG. 4. Case 5. Coxa valga of right side from rickets.

Examination.—Examination upon admission showed the following conditions:

Patient is a well developed child; well nourished. Was born after normal labor, no instruments being required. Was breast-fed for the first two years of life. Epiphyses are slightly enlarged, and abdomen prominent, but no other evidence of rickets. No history of injury.

Patient stands resting the weight on the left, leg with the right foot slightly advanced and the knee flexed. He walks with a decided limp on the right side. In the prone position the foot is slightly everted, the knee slightly bent, and the thigh slightly abducted. Forced flexion is limited. Abduction is extreme and adduction slightly limited. There is no contraction of the tendons about the knee or hip. The right leg is apparently longer than the left. The left hip, as well as the pelvis and vertebræ, appears to be normal.

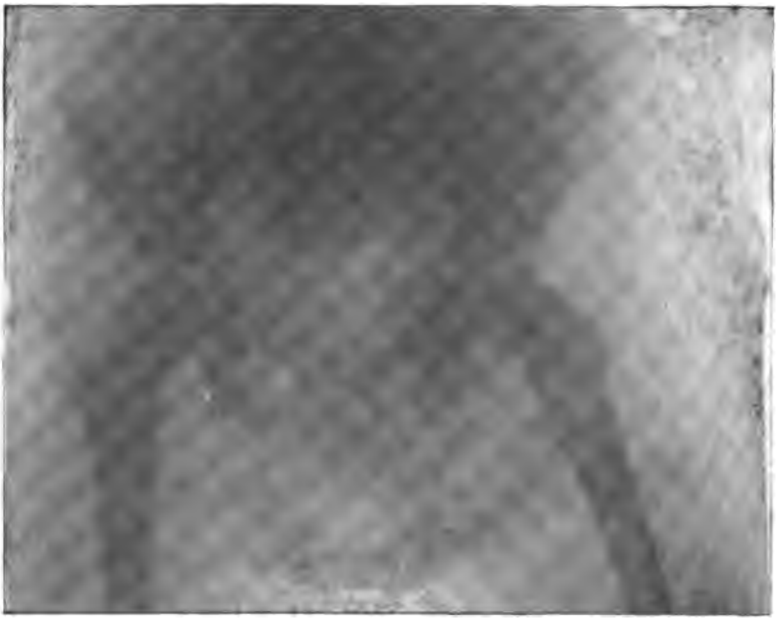

FIG. 5. X-ray photo of Case 5. Coxa valga of right side from rickets.

Patient does not complain of pain and there is no evidence of pain during the examination.

Skiagraph shows the neck of the femur in the right leg to be in a position of coxa valga.

On the right side the angle of depression is 150°.

On the right side the angle of elevation is 63°.
On the left side the angle of depression is 140°.
On the left side the angle of elevation is 35°.

Definition.—Coxa valga may be described as a deformity of the hip-joint due to an increase in the angle of depression characterized by marked external rotation and increased abduction, with limitation of adduction.

Relative Frequency.—In order to determine the normal angle of the neck of the femur, as well as the relative frequency of coxa valga and coxa vara, I[1] have taken the measurements of a large number of specimens in the Museum of the College of Physicians, and the Wistar Museum of Philadelphia.

These were mostly adult specimens of all nationalities and both sexes. Measurements were made both of the angles of depression and the angle of declination. The greatest difficulty was experienced in taking the angle of declination, and in some instances it was necessary to have sections of the bone made to determine them accurately. Any angle of depression between 110° and 135° was considered normal, and any angle below 110° was considered as coxa vara, and above 140° as coxa valga. The lengths of the femur were considered but are not recorded here.

The number of femurs examined at the College of Physicians was 206, and at the Wistar Museum 615, making a total number of 821. Of these there were eight cases of coxa valga, or .97 percent; 52 coxa vara, or 6.33 percent, and the remainder were normal, over 75 percent of these having an angle of 130°.[2]

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[1] With the assistance of Dr. John Read, late resident physician, Philadelphia Polyclinic Hospital.

[2] Of 11 fœtal skeletons examined at the College of Physicians the development was not sufficient to allow of any exact measurements. The head and neck in these specimens were ligamentous and usually in the axis of the shaft. The measurements of the angles of the infant skeletons showed the usual high angles recorded by other writers.

Infants—Wistar Museum.

4204—3 years	Angle	of	inclination	135°.
4205—1 year	"	"	"	145°.
4202—11 months	"	"	"	145°.
4203—1 year, 44 days	"	"	"	150°.
4201—2 weeks	"	"	"	145°.

Specimens of Coxa Valga.

Of the specimens of coxa valga examined, one was due to tubercular osteitis; four to arthritis with exostosis; one to rickets; one to hydrocephalus; and in the others the causes could not be determined from the records.

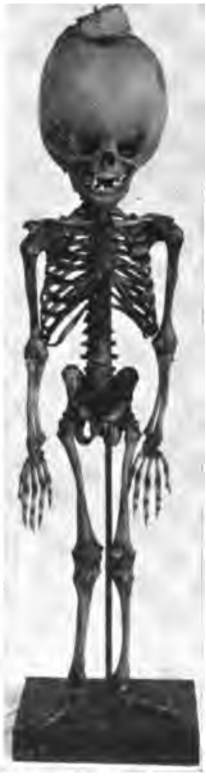

FIG. 6. Angle of 152°. Skeleton of negro child, 6 years. Hydrocephalus, bilateral coxa valga. Circumference of head 70.5 cm., 27.75". The long bones are thin and delicate, and the entire skeleton light in weight.

The angle varies from 142° to 150°.

The specimen of coxa valga from hydrocephalus is exactly similar to one reported by Humphreys, in the Cambridge Museum. In his specimen the angle of each neck was 148°; in mine, 152°.

No example of coxa valga from amputation of the femur in early life like those observed by Turner and Humphreys, was observed.

All of the eight specimens of coxa valga examined were unilateral except the one due to hydrocephalus.

In order to make the examination of the specimens of value every femur in the collection was accurately measured. In this manner it was found that there were 52 specimens of coxa vara among the 821 femurs, 21 of these were found among the 206 specimens in the collection of the College of Physicians which contains mostly pathological material, and 31 were in the Anatomical Institute. The angles varied from 40° to 109°.

There were a large number of specimens of impacted fracture of the neck of the femur with angles below but these were omitted.

Etiology.—The normal angle of the neck of the femur is formed by the opposition of two forces—muscular action and superincumbent weight—these forces being usually sufficient to counterbalance each other and produce a normal angle. If anything should interfere with this harmonious antagonism, and the weight pressure should be removed, or the muscular force should overbalance the weight pressure, the open angle will remain or there will be a reversion to the obtuse angle of fœtal life.

Since coxa valga is dependent upon different pathological conditions a classification founded upon its etiology will be found most satisfactory. Thus: coxa valga may be I.—Congenital, (1) not associated with congenital deformities of other parts, (2) associated with congenital luxation of the hip. II.—Acquired, due to (1) static causes, (2) an incomplete fracture, separation, or displacement of the epiphysis, (3) rickets, (4) osteomalacia, (5) osteomyelitis, (6) exostoses, (7) tuberculosis.

Congenital.—1. Not associated with congenital deformities of other parts.—The existence of coxa valga as a primary congenital affection is established by the publication of a congenital bilateral case by David in which neither rickets nor injury could be demonstrated as antecedent to the deformity. No other congenital cases have yet been reported, but if the attention of surgeons be directed to this deformity the congenital variety will probably be more commonly observed. 2. Associated with congenital luxation of the hip.—It may be questioned, as it was in coxa vara, whether the deformity of the neck associated with luxation of the hip should be considered as coxa valga since the head is out of the acetabulum. The measurement of the angle of elevation proves that these cases should be placed in the category whether associated with luxation or not, and when reduction has been accomplished the clinical symptoms will be identical with luxation. Schulthess and Luning give an X-ray illustration of this kind, and Schede has two excellent examples of bilateral luxation showing the increased angle.

Acquired.—1. Static.—By far the greater number of illustrations, clinical or pathological, have been the result of static conditions. In some instances, as in scoliosis, the unequal distribution of the body weight produces a compensatory coxa valga, and contraction of certain muscles, as the adductors, is sufficient to overcome the pressure force and the open angle results. The same unequal distribution of weight produces coxa valga in luxation of the other hip, or in genu valgum of the opposite side, as in Gangolphe's cases. If, during adolescence, and more rarely in later life, the superincumbent weight be sufficient—as in hydrocephalus—or be removed by paralysis, amputation, or the patient be bed-ridden, or weight be removed from the part by joint disease, the angle present during adolescence remains, or is increased. Under these circumstances, in addition to the absence of the beneficial effect of superincumbent weight, the dangling and hanging of the paralyzed extremity, or the amputated stump, produces a continuous extending influence upon the neck of the femur increasing the angle of depression. Under this head would fall the amputation specimens of Humphrey, and the two cases of amputated stumps of Lauenstein. Another and rarer static cause of coxa valga is sciatica and neuralgia, or neuritis and disturbance of the abductors.

2. Incomplete fractures, separation, or displacement of the epiphysis.—Traumatism more or less severe in character preceded the onset of the deformity in the case of Thiem, three cases of Manz, one case of Hoffa, and in two of my own cases. Thus the angle may be influenced by an incomplete fracture, separation,

or displacement of the epiphysis, with the consequent effect upon the growth of the epiphyseal line causing the growth to be greater on the inner side of the line carrying the head upward, or the growth to be greater on the outer side of the line carrying the head downward or inward, making the angle less.

In one of my cases the traumatism acted in a manner never before observed—an injury inflicted by forceps applied to the breech.

3. Rickets.—This group of cases includes those due to rachitis. Most writers on this subject agree that in some instances the bone softening preceding the deformity of the neck is the result of rachitis, either infantile or adolescent. Hoffmesiter and Grizel have reported cases and Albert observed one specimen.

4. Osteomalacia.—In still other cases the softening process is simply a local manifestation of general osteomalacia. The deformity sometimes escapes detection on account of the bed-ridden condition of the patient, a factor which in itself tends to the production of an open angle.

5. Osteomyelitis.—A specimen of coxa valga from osteomyelitis of the ilium has been observed by Albert. The bending of the bone must take place during the inflammatory stage.

6. Exostosis.—Osteomata and the gouty material in arthritis deformans may, by acting as a wedge, cause coxa valga, as in one of my specimens.

7. Tuberculosis.—Chronic inflammatory processes, of which tuberculosis is the most common, may produce coxa valga by local changes in the neck, as in the specimen in my collection.

Symptoms.—Clinical picture. The deformity develops insidiously, and being associated with or dependent upon other etiological factors, is not recognized until clearly established.

The attitude is characteristic, the contour of the hip is destroyed, and the buttocks flattened. There is slight flexion of the hip, external rotation of the thigh and knee—with eversion of the feet. The internal surface of the thigh looks forward, and the knee is extended.

The essential features which are considered pathognomonic are the *abduction of the leg, associated with external rotation, and limitation of adduction.*

The first symptom which attracts attention is the peculiar gait. In the congenital case reported by David the child was late in walking and the abnormal gait was noticed at the time the child first attempted to walk.

In acquired cases the gait develops so gradually that its onset cannot be definitely determined, but may be from several months to several years after the advent of the fracture or joint disease or paralysis which was the existing cause.

In unilateral cases there is a decided limp due primarily to the inequality of the extremities, and the abducted and outward rotated position of the femur.

When the deformity is bilateral the upper part of the body is swung toward the side of the moving leg—a wavering gait, or, as David describes it, "an alternate swinging of the upper and lower part of the body, which is so characteristic of the gait of sailors."

The gait resembles spastic paraplegia more than congenital dislocation—the feet being raised only slightly from the ground, one leg being bowed forward before the other foot is set down. The causative factor of the swinging gait is the abduction. The patient fatigues more easily than formerly, and pain and soreness are experienced about the hip-joint, particularly in the abductors and glutei muscles from the immoderate effort of these muscles to keep the pelvis horizontal. Adduction is painful and there is sometimes a painful spasm of these muscles.

In bilateral cases the patient falls easily and raises himself up with difficulty, and can stand upon one leg only when supported.

Compensatory changes are shown in the trunk. In unilateral cases the upper part of the body is inclined toward the affected side, the shoulder on the sound side is lowered, and there is lumbar scoliosis, the convex side being toward the affected limb.

In bilateral cases the normal lumbar lordosis is diminished and the upper part of the body is bent forward. Some cases go on for years without detection and with slight inconvenience, while others seek relief from the increasing deformity and total disability.

Objective Symptoms.—The deformity being local in character there is no relation between the general physical development and the deformity unless it be associated with rickets, or osteomalacia, etc. Atrophy of the muscles of the affected part is not marked.

Examination of the affected hip shows the contour changed by the displacement of the upper part of the femur. The great trochanter is anterior to its normal position and is lower than usual, a fact which can as a rule be demonstrated by palpation. This lowering of the great trochanter destroys the isoscelism of Bryant's triangle, as Gangolphe has demonstrated in his case.

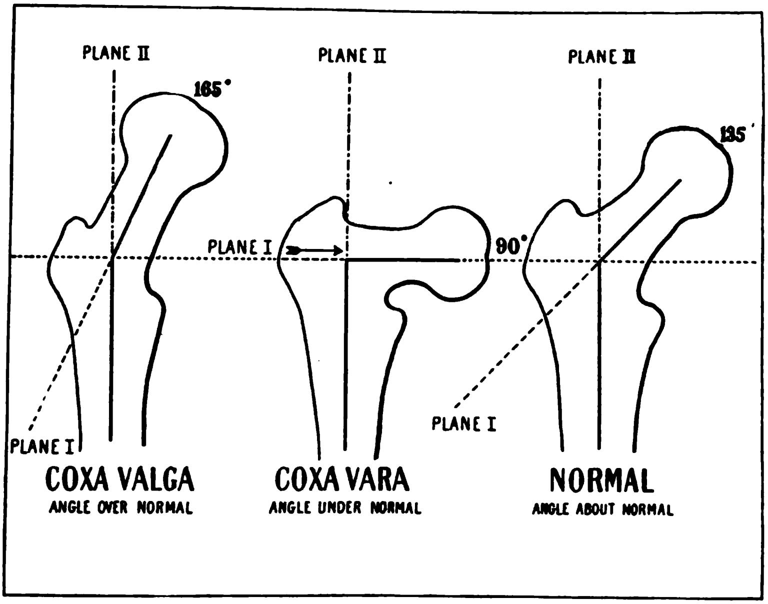

FIG. 7. Original diagrams illustrating angle of depression.

The trochanter may also be shown to be on or below Nelaton's line. The head of the femur is forward and its axis antero-posterior. The head may sometimes on deep pressure be felt to be within Scarpa's triangle.

In the skeleton we have shown anatomical alterations in the angular relations between the femur and the pelvis, and in the angular relations between the epiphysis and the diaphysis of the femur, beside the other alterations. The angle formed by a plane passing through the long axis of the neck of the femur and a second plane passing through the vertical median line of the body is exaggerated in coxa valga. The angle formed by a plane passing through the pelvic bones, and a second plane passing through the long axis of the diaphysis of the femur is also exaggerated.

In alterations between the epiphysis and diaphysis of the femur we may employ three methods of measuring—the angle of depression, or angle of declination, and the triangle of Alsberg. The angle of depression—so called by Mikulicz—is formed by two planes, one passing through the long axis of the epiphysis and a second, in longitudinal section, passing through the long axis of the diaphysis. The arc of the normal angle appears to me to average 130°.[1] These measurements are in the adult, as in infancy the angle is greater, and in senility usually smaller. Sometimes, even in marked cases of coxa valga, the alteration in the angle of inclination is slight owing to twisting of the neck of the femur upon itself.

The angle of declination is represented by two planes (in horizontal section), the first plane passes transversely through the shaft of the femur dividing it into an anterior and posterior position, the second plane passes through the direction of the long axis of the epiphysis. These planes form an angle which is approximately about 165°. The angle is directed forward and within. In coxa valga the great trochanter is anterior to the normal position and the long axis of the femoral neck almost antero-posterior. The angle may be diminished to about 110° (Gangolphe's case), and the angle is directed backward and without. In coxa vara the angle is directed forward and without, the great trochanter being posterior to normal. This angle is of course difficult of demonstration except diagrammatically as it may only be shown by horizontal section of specimens.[2]

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[1] Hoffa gives 126° as the normal. Mikulicz 125°–126°, Lauenstein 126°–129°, Alsberg 128°, and other authorities increase this angle as high as 140°.

[2] While the statement here made is in general true many exceptions were met with in the examinations of the specimens of coxa vara and coxa valga recorded in this paper. Specimens were encountered where marked coxa vara existed and the angle of declination was greatly diminished (10,591), the long axis of the femoral neck being exactly transverse. Others were examined where the angle of declination was greatly increased and the femoral neck retained the normal angle of inclination (10,386). These variations may be considered valuable as proving the rule.

Alsberg's triangle is formed by a line passing through the long axis of the femur and its continuation, a second line passing through the long axis of the neck of the femur, and a third line on a plane passing through the base of the head and parallel to a notch in the head and its continuation. In the normal condition the triangle is approximately equilateral, the apex upward. The angle formed at the apex is called by Alsberg the angle of "elevation." In coxa valga there is a shortening of the third line, the apex upward, and in coxa vara the triangles are reversed and the second line shortened.

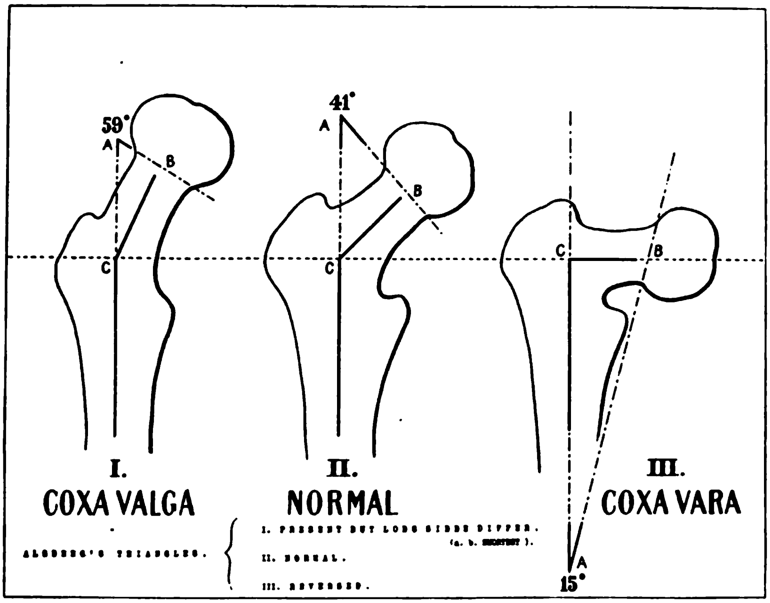

FIG. 8. Original diagrams illustrating Alsberg's triangles.

Abduction is easy and increased; adduction is painful and sometimes the knee cannot be brought inside of the median line. Flexion of the thigh upon the pelvis is interfered with, and the knee can seldom be made to reach the abdomen. There is an actual lengthening of the affected limb between the pelvis and knee, and not between the trochanter and the knee. The neck of the femur is longer than normal in coxa valga and it is from this lengthening and from the increase of the angle of depression that the actual lengthening of the bone is due. In rachitic cases there may be a bowing of the femur affecting this increase.

The X-ray is the best method of demonstrating the existence of this deformity but in some cases owing to forward dislocation of the trochanter the picture of the affected hip is not so clear as the other. The picture of both hips should always be taken, and the anterior position is best.

Treatment.—Less attention has been paid to the treatment than to any other phase of the subject.

Utilizing Wolfe's transformation law David succeeded in improving the angle of depression in his case 7° with a corresponding improvement in function, by fixing the hip in a cast in an exaggerated position of adduction and inward rotation.

Two of my own cases were improved by tenotomy. In older cases equilization of the limbs by the use of a high shoe on the sound side will not only improve the gait but will to some extent improve the angle of depression by changing the direction of the weight.

When the incipient stages have passed operative methods must be employed. An apparatus which would hold the leg in adduction with internal rotation would be of service during the incipient stage.[1]

In severe deformity with great disturbance of function, especially where associated with rheumatoid arthritis, a formal excision would be justifiable.

Cases of Coxa Valga Published Previous to Presentation of this Article.

Case i.—(Mauclaire, 1894–95.) Coxa valga in scoliotics, especially in those having right dorsal convexity. The patient turns sideways to maintain the equilibrium, carrying the right limb in exaggerated abduction and rotation. If the lesion occurred before adolescence the femoral neck would probably be twisted.

(March, 1894). Autopsy was made and showed an angle of declination of 110° in the antero-pesterior axis of the femoral neck. Did not form an angle of more than 15° with the body. Internal rotation was impossible. Abduction was greatly limited. Also exhibited other specimens.

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[1] Subtrochanteric osteotomy will be the operation of choice, and the bone should be retained in a position of adduction.

Case 2.—(Hoffmeister, 1894.) Case observed similar to Gangolphe's but his patient also exhibited signs of rachitis.

Case 3.—(Grisel.) Case in a child of four, with rickets.

Case 4.—(Theim, 1897.) Case following fracture, in child.

Case 5.—(Hoffa.) Case of traumatic coxa valga after fracture of neck.

Case 6.—(Reichard, 1901.) Case after club-foot from anterior poliomyelitis. Trochanter major was 4 cm. below Nelaton's line. The trochanter minor was prominent.

Cases 7-8-9.—(Lauenstein.) One case due to rickets. Two cases due to amputation stumps.

Case 10.—(Gangolphe and Hau.) A man 20 years of age who had septic process in knee causing genu valgum. Had coxa valga on the other side, also due to septic process. Was unable to walk. Also had phthisis.

Case 11.—(Hoffa.) Case following infantile palsy, with both trochanters in Nelaton's line. Diagnosis made by X-ray.

Case 12.—(David.) Boy, 5 years old. No rickets, infantile paralysis, or injury. Early in 1903 was treated for progressive muscular dystrophy with pseudohypertrophy. October, 1903, was examined by David who found both limbs markedly abducted, trochanter in Nelaton's line, and adduction and inward rotation diminished.

Specimens Mentioned in Literature.

Humphreys (1898) mentions four specimens from the Cambridge Museum in which the angle is given:—one from hydrocephalus, the angle of each neck being 148°; two from paralytic limbs, the angles being 143° and 150° respectively; and one from a limb amputated from a lad which it was inferred had not borne weight for some time prior to the operation, and in which the angle was 142°.

Albert mentions eight cases:—one associated with paralysis of the legs; one with weakness of the legs but no paralysis; one with osteomyelitis of the pelvis; one with rickets, one with osteomalacia; one with multiple exostoses; one with luxation of the other hip; and one with genu valgum.

Turner mentions three specimens:—one from an amputation in early life, with an angle of 150°; one associated with tuberculosis of the ankle and knee; and one from fracture of the lower end of the femur with separation of the epiphysis.

Lauenstein notes three specimens with angles of 140°, 146°, and 155° respectively.

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SPECIMENS OF COXA VALGA IN THE PHILADELPHIA COLLEGE OF PHYSICIANS.

1174-34-4. Angle of 145°. Arthritis and deformity of head.

1175-34-4. Angle of 142°. Upper ⅓ of left femur, caries of head and neck. Head and upper part of neck missing. Adjacent surfaces of bone are rough and show more or less periosteal deposit. In the remains of the neck there is a cavity 1.5 cm. deep but not showing any sinus. Vertical section shows a healthy shaft and healthy, spongy tissue of the trochanter najor.

1168–35–4. Angle of 142°. Arthritis and exostosis of head. There is no malformation except at the junction of the head and neck which is marked by a thick and prominent overhanging ridge of bone. At the inner side of the head this ridge is prolonged to the pit for ligamentum teres.

1171–35–4. Angle of 150°. Arthritis and deformity of head. Exostosis and eburnation.

1229–34–6. Angle of 150°. Anterior bowing of shaft of bone. Axis taken from upper shaft. Rickets, adult bone, but only 31 cm. in length. Posterior wall thick, anterior wall thin.

2069. Angle of 145°.

10300. Angle of 145°.

VII.

A METHOD OF REDUCTION OF CONGENITAL LUXATION OF THE HIP BY MANIPULATION.

GWILYM G. DAVIS, PHILADELPHIA, PA.

The methods of reduction of congenital luxation of the hip that have been and are in common use are those of Paci as modified by Lorenz.

Paci's method followed the principles generally accepted in the treatment of traumatic luxations. In general terms it might be called the circumduction method and was as follows: The thigh was flexed on the abdomen, then abducted with outward rotation and extension to as great a degree as possible without allowing the head to again become dislocated. To aid in abducting he used the edge of the table as a fulcrum.

Lorenz used extension and increased the abduction to a right angle.

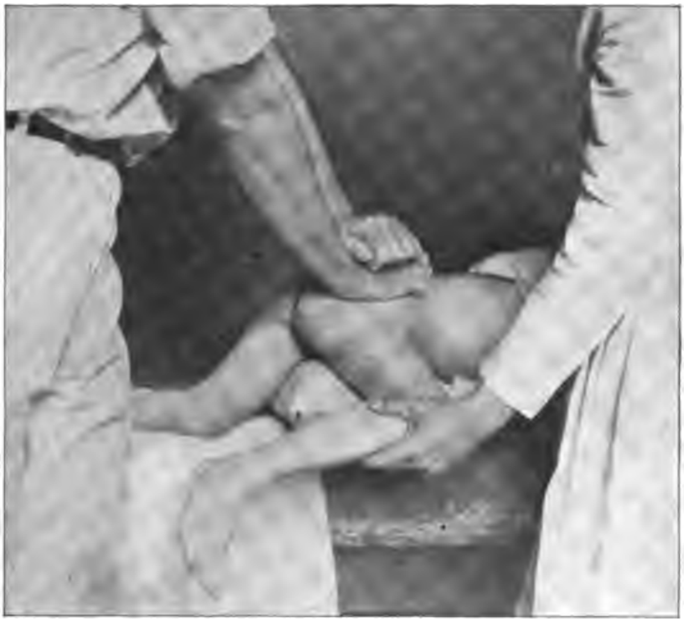
The use of extension has largely been abandoned although I believe it still forms a feature of the Bartlett reduction apparatus as used in the Children's Hospital of Boston.

The method now in use therefore consists in flexion, abduction with a certain amount of rotation.

It is well known that the reduction of a congenital luxation of the hip necessitates often the use of considerable force, in the exercise of which many deplorable accidents have occurred. The object of the present method is to exert the maximum of force with the greatest degree of safety to the patient. It aims to substitute direct pressure for lever action. The most difficult part of the reduction is in bringing the head of the bone from a posterior to an anterior position. To accomplish this the following method is suggested.

The child is placed face downward on the table with its pelvis resting on a sand pillow and the leg to be operated on hanging down over the side of the table.

An assistant now grasps the knee with one hand and the shaft of the femur beneath with the other and flexes and slightly abducts the limb, steadying and supporting it against his body. The surgeon then places his hands over the head and trochanter and presses downward with the weight of his body. As the pelvis is supported by the sand pillow this tends to push the head forward. This manipulation is repeated, the assistant gradually abducting the thigh (raising the knee) more and more until the amount of abduction desired is obtained.



Reducing a congenital luxation of the hip.

In some instances the head of the femur is felt to glide forward, in others it seems to "crunch" (crush) forward and in others it jumps forward with a distinct click. After it has once been pushed forward it can usually be readily luxated and replaced at will.

In difficult cases the thigh should be well flexed and the femur well supported by the assistant with one hand at the knee and the other well up on the shaft. Tenotomy of the adductor longus tendon is always done previous to attempting reductions.

This method has been used in five cases varying from 3½ to 8 years and reduction effected in all without either difficulty or accident. One had previously been treated unsuccessfully by the usual method by another surgeon.

VIII.

POTT'S DISEASE.

COMPTON RIELY, M. D., BALTIMORE, MD.

Forward tilting and projection of the pelvis (Fig. 1) through the medium of the abdominal muscles and fascia, and the ribs, is an important factor in the production of deformity in Pott's disease, as in lateral curvature of the spine,[1] and the former is always present in all cases, high or low, before angular deformity has taken place.

I first noticed this condition (forward tilting and projection of the pelvis) in 1900 and realized that to obtain the best results in the straightening of the spine it would be necessary to tilt it back to its normal position, and called Dr. R. T. Taylor's (Baltimore) attention to this fact; also a model of a device that I made to attach to his kyphotone to hold the pelvis in its normal attitude while applying plaster jackets. He photographed this model attached to his kyphotone and reported it in 1901 in a paper[2] giving me credit for its invention as well as for having first noticed that the lordosis in Pott's disease was principally due to the forward tilting of the pelvis. (This apparatus was not made owing to lack of funds.)

The pelvis tilts forward and the spine becomes more erect at first, increasing the distance between the origin and insertion of the abdominal muscles, giving them greater power to act in conjunction with the muscles of the back in immobilizing and overextending the spine at the seat of the disease and throws the weight-bearing line farther back than normal. Later when the abdominal muscles become stretched, the fascia acting in their stead, the pelvis also *projects* forward, and the dorsal spine backward, which throws the weight-bearing line farther forward than normal, (compare Figs. 1, 2, 3) and pulls that part of the spine above the

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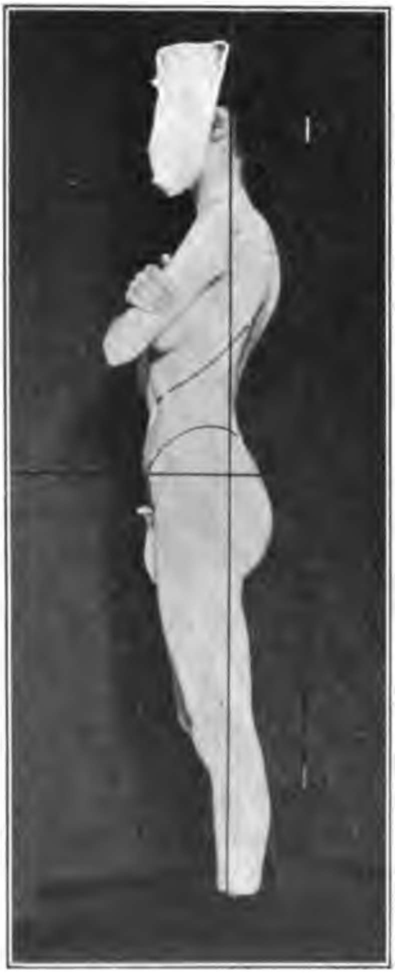
[1] Read before the American Orthopedic Association, May 14, 1903, and published in the American Medical Journal, April 2, 1904.

[2] The Johns Hopkins Bulletin, Vol. XII, No. 119, February, 1901.



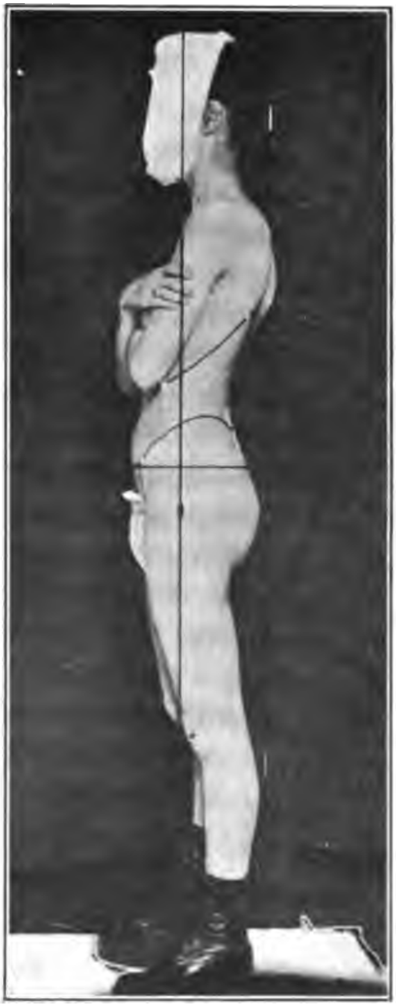
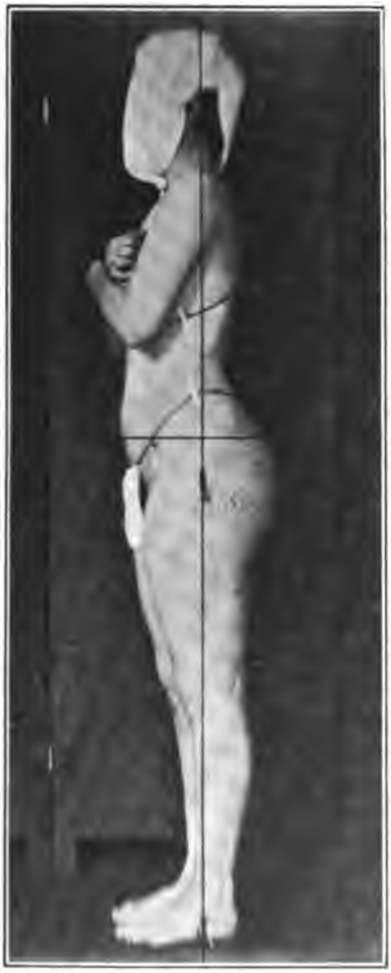


FIG. 1. Shows a forward tilting and projection of the pelvis, marked lordosis, round shoulders, increased obliquity of the ribs, and the weight-bearing line passing over the ear, just in front of the malleolus and far behind the great trochanter.

FIG. 2. Same case as Figure 1. Shows plumb-line opposite the great trochanter and far in front of the ear and malleolus.

seat of the disease farther forward and downward. The angle formed by the horizontal line on the level with the anterior superior spine and by the one corresponding to the crest of the ilium is more obtuse than in the normal. (Compare Figs. 1, 2, 3.)



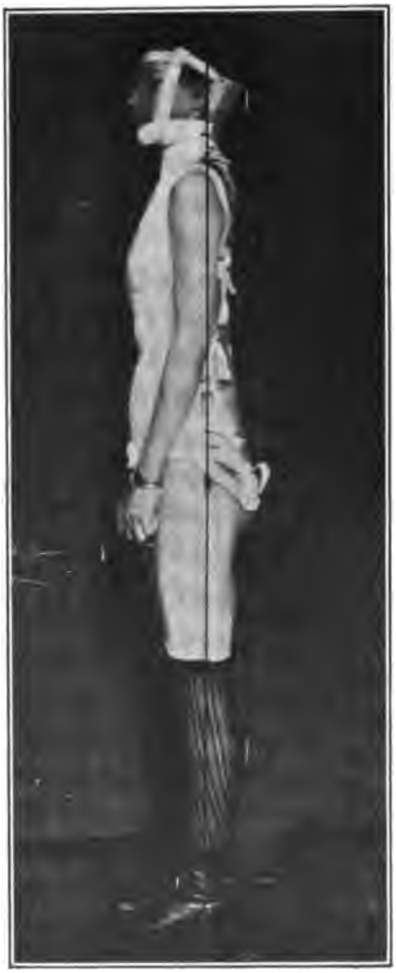


FIG. 3. A normal person who is rather fleshy for comparison with Figures 1, 2, 4, 5.

FIG. 4. Patient with high dorsal Pott's whose normal weight-bearing line has been restored. Compare with Figures 1, 2, 3.

When on examining the abdominal muscles of a patient in the early stages of Pott's disease before angular deformity occurs, they will be found to be tense. We know that the motion at the costo-vertebral articulations is limited and that through the intercostal muscles and fascia, the sternum, the costal cartilages and

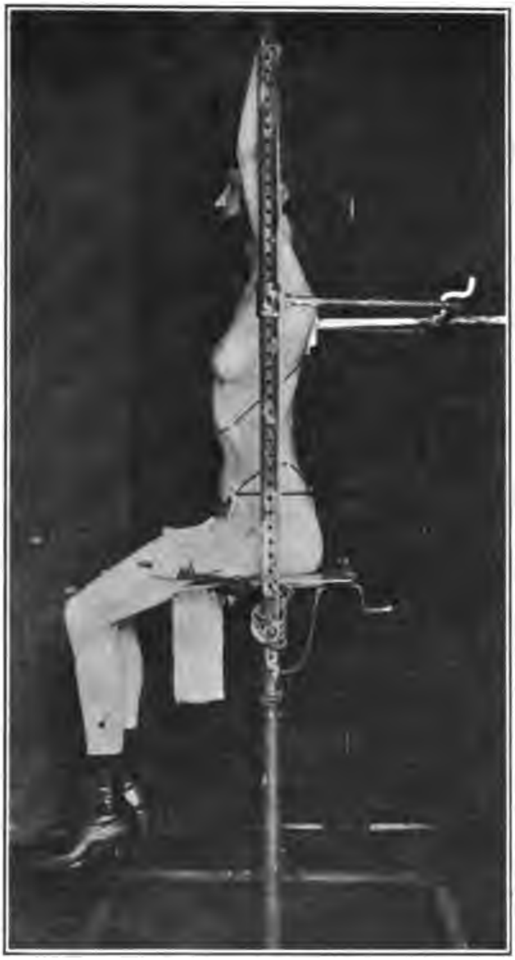


FIG. 5. Same case as 1 and 2. Shows antero-posterior thickening of the chest, reduction of the round shoulders and lordosis, restoration of the pelvis to its normal position and the ribs more horizontally directed.

ribs swing upward together when acted upon by the muscles connecting them with the head, upper spine, shoulder girdle and arms; or downward when acted on by the abdominal muscles and fascia which connect them with the pelvis. When the limit of this upward or downward motion is reached, the spine is acted upon, being extended by their upward motion and flexed by their downward motion. Taking these facts into consideration it can be seen how a forward tilting of the pelvis, which lowers the pubis, pubic rami and the front part of the iliac crests, must necessarily pull down on the abdominal muscles and fascia which are attached to these points, which in turn pull downward and forward on the front ends of the ribs (compare Figs. 1, 2, 3) and sternum making them oblique, to a degree limited by the ligaments which connect them with the spine, and their close contact with each other, flattens the chest and pulls that part of the spine above the seat of the disease farther forward and downward.

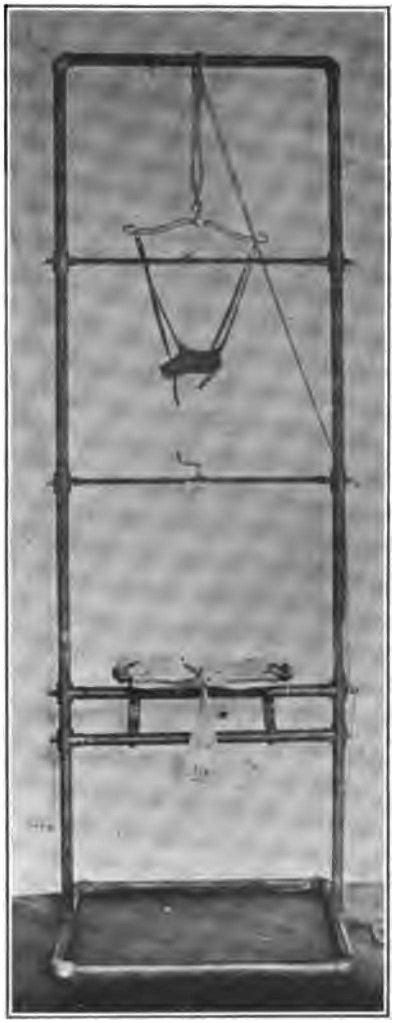


FIG. 6.

Adults suffering from Pott's disease in the cervical or upper dorsal region before deformity has taken place, almost invariably complain of pain in the lower limbs, lumbar, sacral or coccygeal regions, so much so at times as to make one think that the disease is in that region. Many cases also complain of marked pain over the region of the scapulæ, severe hyperæsthesiæ, marked and persistent constipation, and at times of frequent urination.

Early in the disease, long before this occurs, slight angular lateral deviation of the spine frequently takes place (Figs. 7, 9, 10); increased deep reflexes, especially the knees, marked persistent constipation, referred pains, usually unilateral, increased tension of the abdominal muscles, nausea and vomiting are among the earliest and most constant symptoms, where the disease is in the cervical or dorsal region, and should greatly aid us in making an early diagnosis long before the bodies of the vertebræ have been sufficiently destroyed to cause a hump.

By this means, I have been able to make a diagnosis of Pott's disease in adults which strongly simulated coxalgia, etc. The peculiar gait, attitudes and rigidity of the spine are not shown as early in adults as in children, most of them can in the early stage be put through the forward bending tests, etc. Referred pains in the adult are usually unilateral and seem to be more severe and remain in one location longer, so much so as to cause these patients to be treated for various diseases, such as rheumatism, paralysis or partial paralysis, gout, angina pectoris, neuritis, pneumonia, pleurisy, intercostal neuralgia, gastritis, gastric ulcer and cancer, hepatic and nephritic colic, floating kidney, cystitis, ovaritis, endometritis, appendicitis, sacro-iliac disease, coccygodinia, coxalgia, hysteria, sciatica, locomotor ataxia, neurasthenia. etc., many undergoing exploratory operations, the surgeons not finding the conditions they suspect and of course, not relieving the patient's suffering. I have under my care now several patients that have undergone operations for floating kidney, appendicitis, endometritis, coxalgia, etc., by general surgeons, without relief, in whom the X-rays (Fig. 7), have shown abscesses and who have since been relieved by mechanical treatment.. I believe this disease is much more common in the adult than is generally thought and that when severe nonfebrile symptoms that have not yielded to continued and varied treatment occur, one should be lead to examine and X-ray the spine.

We should bear in mind that the bones in the adult are much larger and harder, hence the slow destruction and great length of time which usually elapses before complete paralysis or angular deformity presents itself. It is a well known fact that cold abscesses in adults will grow so large that they will present themselves at some point on the surface of the body long before a hump occurs.

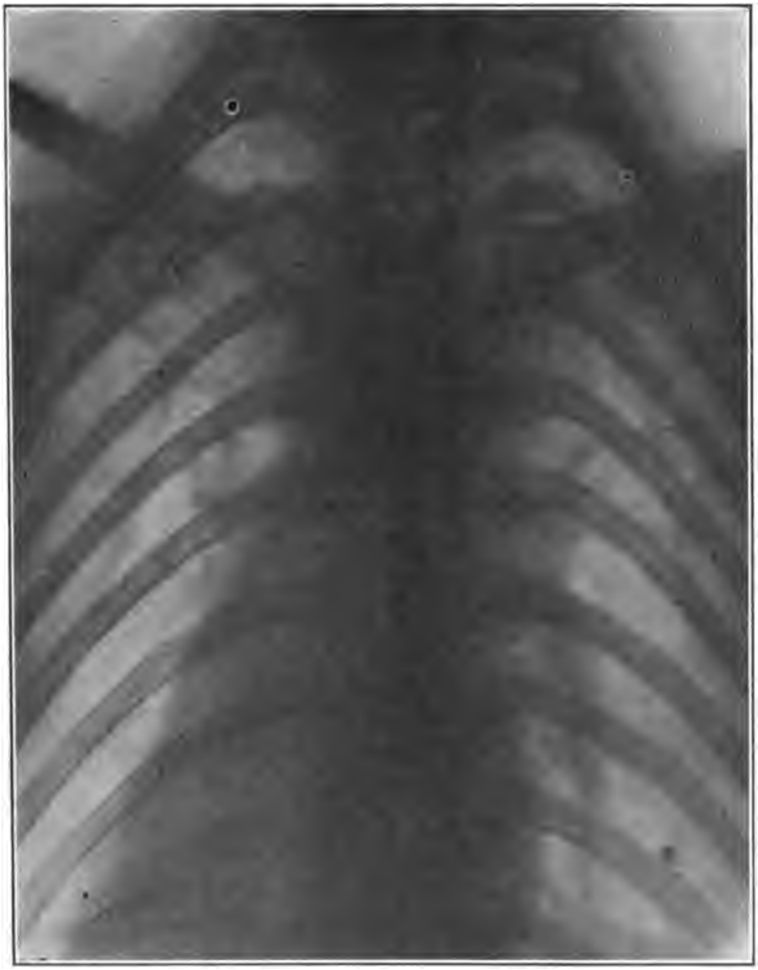


FIG. 7. X-ray of spine of patient seen in Figure 1, aged twenty-one years, showing an abscess extending between the seventh and eleventh dorsal vertebræ. No destruction of bone can be detected. No angular kyphosis.

I have a number of adult cases under my care, who have no hump whatever and whose symptoms date back some years (one as long as seventeen before her case was diagnosed), some of whom have had total or partial paralysis of the legs, arms or hands, and in whom the X-ray has shown the disease and in whom the symptoms have yielded to treatment.

Early diagnosis, especially in the adult, is very difficult and can be greatly aided by the X-ray if properly taken; what I mean by properly taken is, so that it will show the abscess when one is present.

Abscesses, especially in the adult, will be present and will be shown by the X-ray long before there is sufficient destruction of bone that could be detected before the occurrence of a hump. The same might be said of children, though not to such a degree. (Fig. 8.)

To obtain an X-ray that will show an abscess, the tube must be soft enough to make the shadow of the bones look fairly dark, and kept that way while using a very rapid spark. An X-ray not taken in this manner is of no use and may be misleading in giving the proper results.

In the treatment of Pott's disease, except lower lumbar, the pelvis should be restored to its normal position (Figs. 1, 4 and 5), which will better enable us to hyperextend the spine at the seat of the disease, thereby restoring the spinal column and ribs to their normal position, enlarging the thorax, relieving the pain, paralysis, etc. When the trouble is below the eighth dorsal, and there is no paralysis and the pain not very severe, I apply a plaster-of-Paris jacket while the patient is held in a corrected position by means of an apparatus which I had made in 1904 (Figs. 5 and 6). It consists of a frame about twenty-six inches square which rests on the floor and acts as a base for the two pieces of pipe about eight feet long, erected one on each side, being joined at the top by another piece of pipe of the same width as the base, and from the centre of which there is a hook from which is suspended the pulley for the head-sling. Extending between the two uprights, there is a hand bar, pressure rod and a seat, all of which can be adjusted to suit the size of the patient by means of holes about one inch apart in the two uprights. The width and length of the seat can also be adjusted by means of a crank. There is a broad piece of webbing which passes from the adjustable sides of the seat over between the thighs, down through the centre of the seat

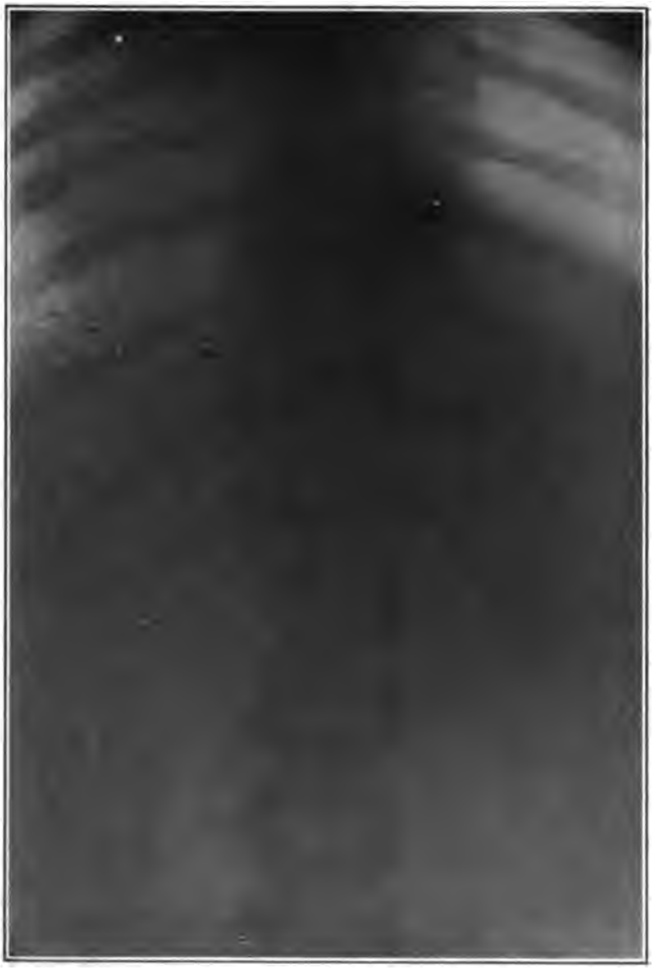


FIG. 8. X-ray of spine of child seven years old, showing an abscess extending between the eighth and twelfth dorsal vertebræ. No apparent destruction of bone, but of the intervertebral disk between the tenth and eleventh dorsal vertebræ. No angular kyphosis.

where it can be made fast, the thighs by this means acting as levers to tilt the pelvis backward.

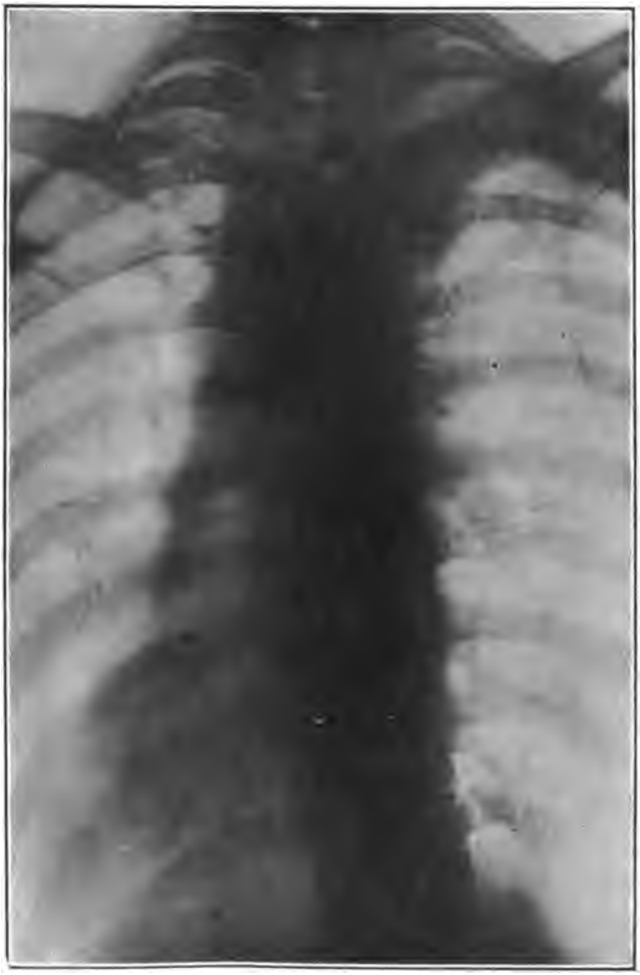


FIG. 9. X-ray of spine of patient aged fifty-six years, showing abscesses extending between the fifth and eleventh dorsal vertebræ. No apparent destruction of bone. No angular kyphosis. Slight lateral angular deviation at the junction of the second and third dorsal vertebræ.

When the disease is acute and accompanied by increased deep reflexes, pains, nausea, vomiting, paralysis, resistant lordosis, round shoulders, etc., the patient should be put to bed on an apparatus of proper size and character that will reduce the lordosis and the round shoulders and allow the pelvis to be tilted and thrown backwards. The head of the bed should be elevated from four

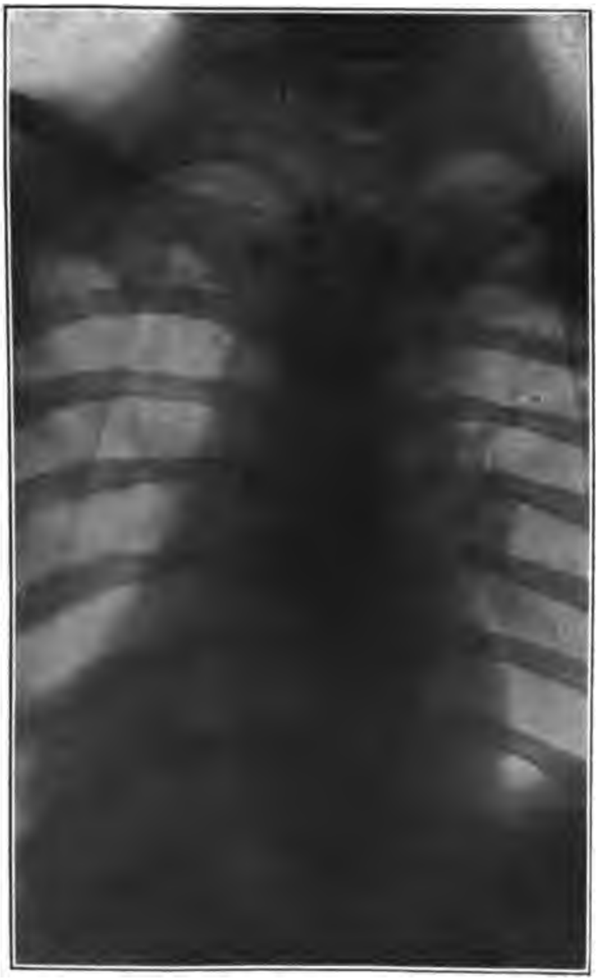


FIG. 10. X-ray of spine of patient aged thirty-five years, showing abscesses with two sacculations, one extending between the second and sixth dorsal vertebræ and the other between the sixth and eleventh dorsal vertebræ. No apparent destruction of bone. No angular kyphosis but a slight lateral angular deviation at the junction of the third and fourth dorsal vertebræ.

to six inches so that the weight of the body by means of gravity will enable the patient to do without Buck's extension straps. The head-sling with weights is applied, the weight varying according to the size and endurance of the patient. The apparatus

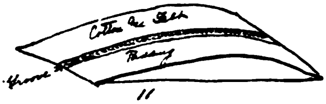


FIG. 11.

(Fig. 11) on which the patient lies, is a kind of box, the width of the patient's shoulders and extending from a point on the back opposite the anterior superior spines, to the occipital protuberance. Its upper surface should be well padded with cotton and felt, and convexed to suit the case. There should be, and in the median line, a longitudinal groove in which rests the spinous processes. The apparatus in all cases should be made so as to hyperextend

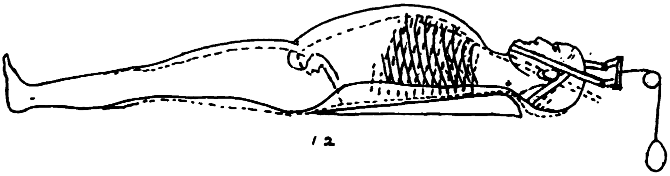


FIG. 12.

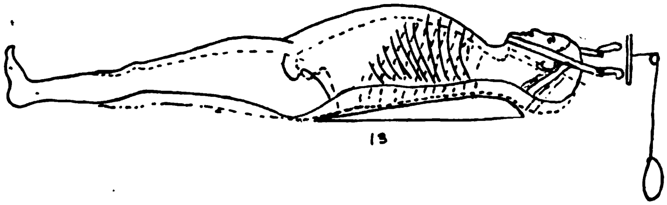


FIG. 13.

the spine only at the seat of the disease and so as to allow the pelvis to sink and tilt backwards and resume its normal position. (Figs. 12, 13, 14, 15; dotted lines.) Should the disease be in the cervical region, the apparatus should extend from a point on the back, opposite the anterior superior spines by a thin edge gradually sloping in a straight line to a point opposite the seat of the disease and then curving suddenly to fit the neck and occiput in a hyperextended position (Fig. 12).

Should the disease be in the dorsal region, the apparatus is made to extend from the same point below by a thin edge gradually sloping in a straight line opposite the seat of trouble, then sloping downward to the head until it reaches the neck where the slope is sudden so as to fit the occiput. (Figs. 13, 14.)

Should the disease be in the lower lumbar region, the apparatus curves rather suddenly upward to the point opposite the seat of the disease and then slopes slightly downwards toward the head where it curves suddenly so as to fit the occiput. (Fig. 15.) These supports are usually two to three inches high for adults and from one and a half to two inches high for children. These supports can be used in connection with the Bradford frame or can be attached to a wooden frame. The patients remain in the apparatus until all pain, nausea, vomiting, paralysis, etc., have subsided, and the line of the centre of gravity has been brought back to its normal position (see dotted lines in Figs. 12, 13, 14, 15) when a jacket or brace is applied and the patient is gotten out of bed and allowed to go about. At first the bed treatment is very tire-

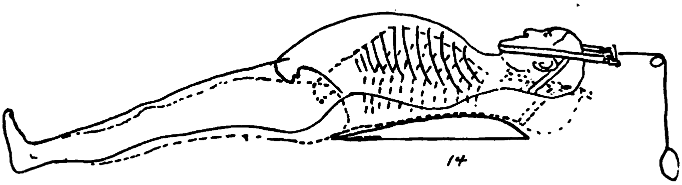


FIG. 14.

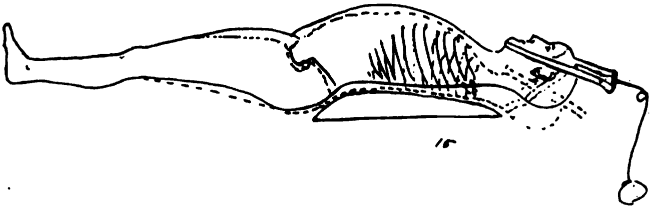


FIG. 15.

some and will require much persuasion to make the patient persist in it, but later they become reconciled. Children seem to stand the treatment much better than adults. When the disease is above the eighth dorsal vertebra a brace that will support the head, spine and pelvis should be applied.

At the meeting of 1904, I was forcibly impressed with Dr. Young's modified Dollinger brace and determined to try it, using hard felt for awhile. Then I began to make them of plaster reinforced with steel, modifying it by having a piece of steel running up the centre of the back, forking a little below the point of the posterior fontanel, forming arms that projected beyond the plaster as far forward as the outer ends of the supra-orbital ridges and opposite the prominent part of the forehead. On the inner side of each of these arms were two buckles, one for the lifting strap of the chin-sling so as to obtain a more direct upward pull and the outer for the brow-band.

In making the casts over which to shape the brace, I realized that to get the pelvis tilted and thrown backward, that the lordosis and kyphosis in the cast should be corrected, which I proceeded to do by the method herein described, and which was reported in part, by Dr. R. T. Taylor (Baltimore) at last year's meeting[1]. The plaster being heavy and not very durable, I decided to try aluminum. Not wanting to use steel reinforcing and at the same time having it inflexible, I decided to try ridging it lengthwise in the centre on its posterior surface. This I found answered the purpose perfectly.

(Fig. 16.) This is an aluminum back brace which I devised and wish to present, having used it with much satisfaction for over a year. It is made of sheet aluminum varying in thickness from one-sixteenth to three-thirty-seconds of an inch, according to the size of the patient. It is perforated, lined either with felt or kid, and when using the latter the groove should be first padded with felt. It has an aluminum arm projecting forward on each side of the head above the ears and nearly on the level with the prominent part of the forehead extending as far forward as the outer ends of the supra-orbital ridges; on the inner side of each

[1] American Journal of Orthopedic Surgery, Vol. III, page 367, April, 1906.

of these there are two buckles placed one in front of the other, the front ones for the chin-sling so as to get a direct upward pull and the other for the brow-band. There are also buckles for the apron, collar and the traction straps of the chin-sling along the side. On the adult braces there are three buckles on each side of the lower end arranged so that the lowest straps on the sides of the apron will make traction below the anterior superior spinous processes, the second one just over the anterior superior spines and the third just above them, so as to obtain a firm hold below and produce traction back and upward. There is a longitudinal groove on its anterior surface about one-half inch deep and extending along the centre of the brace as high as the occipital protuberance and tapering from below upward; this answers three purposes, one to act as a reinforcement to prevent the brace bending, one to keep the spine from deviating to the side, and the other to distribute pressure on all the processes, the spinous as well as the transverse. This brace is light, durable, adjustable and comfortable. The patient is held to the brace by means of an apron (Fig. 17), axillary straps, collar, chin-sling and brow-band. The apron is fitted so that the darts will follow the costal arches which enables it to have a lift-

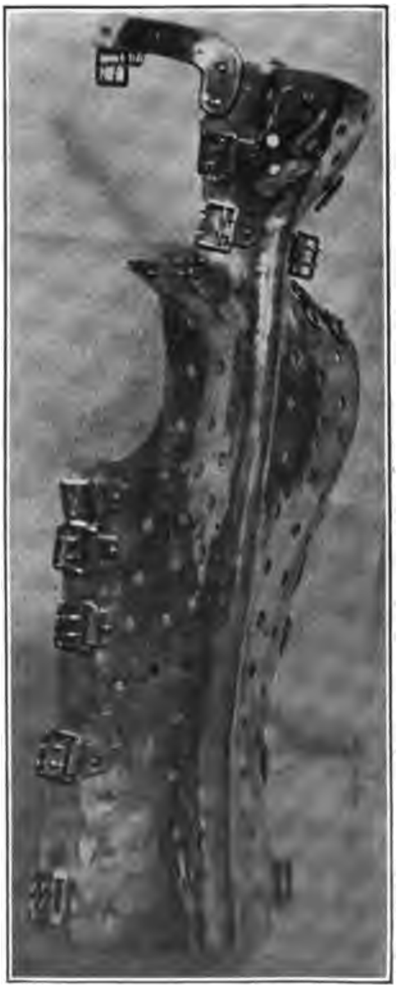


FIG. 16.

ing power at these points, so as to raise the sternum and front ends of the ribs, which aids in hyper-extending the spine. The collar is joined to the apron in front of the supra-sternal notch by

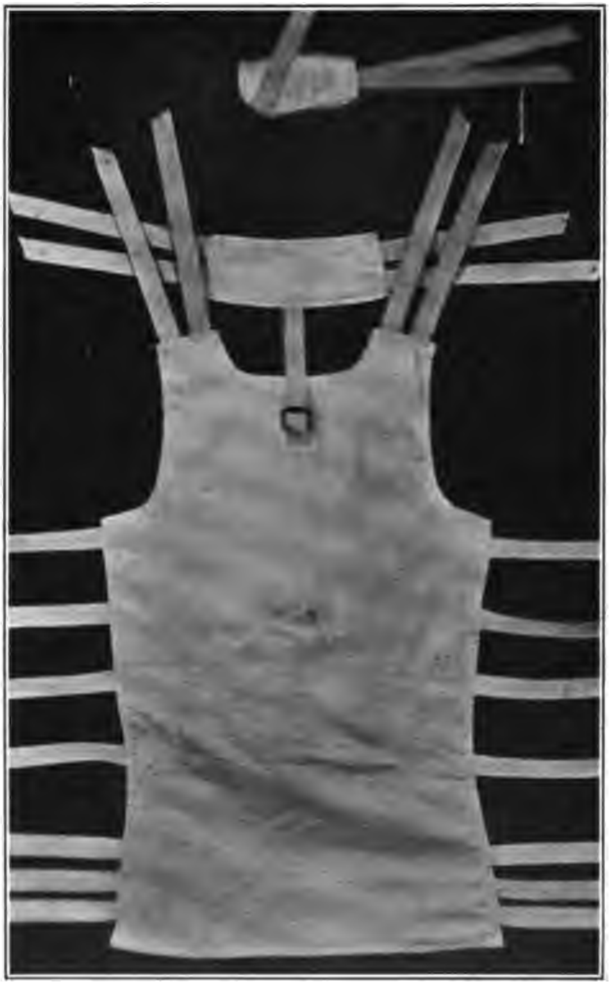


FIG. 17.

means of a strap and buckle so that it can be adjusted not to allow it to choke the patient. The chin-sling has two sets of straps, one for lifting and the other for retracting.

Needless to say that much care is required to obtain the corrected plaster model from which a metal cast is obtained over which the brace is hammered into shape. An impression is obtained, with modeling compound, of the patient's back, neck, and back of head with the patient in the prone position.

A shell plaster cast about one and one-half inches thick is carefully corrected laterally and antero-posteriorly, if necessary; having that part of the cast which represents the spine perfectly erect with the shoulders and hips level, greatly reducing the lordosis in the lumbar and cervical regions and entirely correcting the round shoulders to represent a normal back, if there is little or no angular kyphosis; otherwise according to the degree of deformity, always having it less marked than that of the patient. Prominences should be built over the region of the scapulæ so as to make the pressure of the brace lie mostly over the spinal column, and the back between the shoulders. There is a longitudinal straight ridge of plaster made along the middle of the back as high as the occipital protuberance and should taper from below upward, it should be about one-half inch high, from three-quarters to one

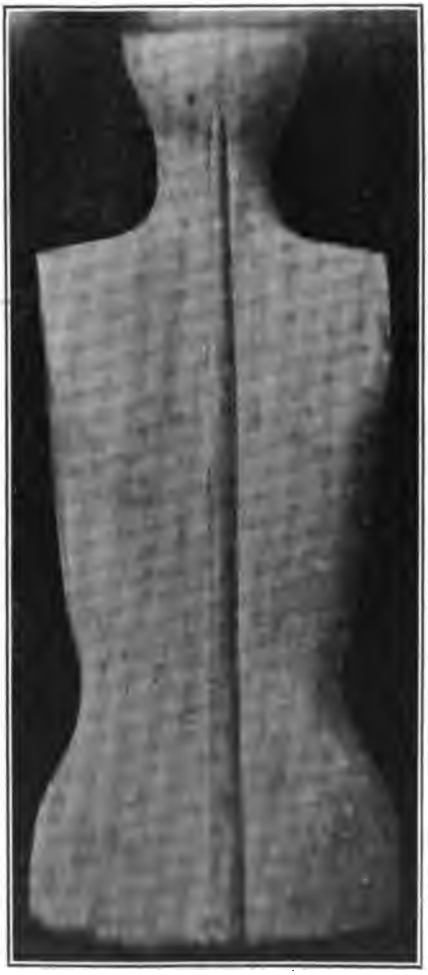


Fig. 18.

inch wide at the bottom and from three-eighths to five-eighths of an inch wide at the top (Fig. 18). Then the back surface of the cast should be smoothed with sand paper.

These corrections are made as follows:

The spine is traced out and straight lines are made between the points of the lateral curves, which generally correspond with the antero-posterior curves, at which points there should be made transverse lines at a right angle to the sections of the irregular vertical lines. The cast is sawed across at these transverse lines thus removing V-shaped pieces of plaster for the lateral corrections

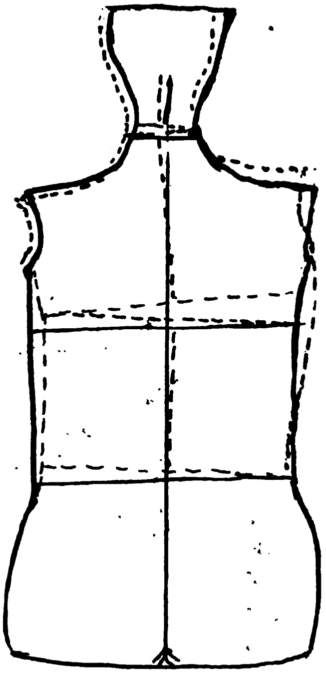


FIG. 19.

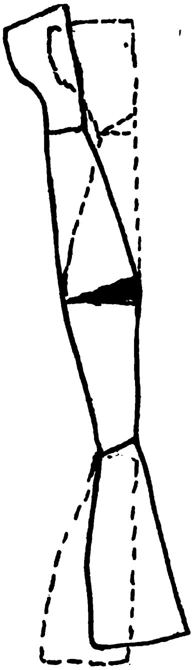


FIG. 20.

FIG. 19. The back view of cast. Dotted outlines represent the cast before correction. The dotted cross lines represent points at which it should be sawed. The solid outlines represent the cast sawed. The solid outlines represent the cast and the solid cross lines the points at which the sections have been united.

FIG. 20. The dotted lines represent the lateral view of the cast uncorrected and the solid lines the corrected.

and lordosis and leaving V-shaped spaces at the point of kyphosis. (Figs. 19 and 20.)

The inner surface of the ends of each section are beveled to the edge. The bottom piece is fastened in a vice with the central line vertical and the pieces joined together by wet plaster, placing each piece correctly before joining. A tracing of the patient's spine and head with lead tape or cardboard is very useful, as a source of reference while correcting the cast.

I also wish to present an adjustable head support to be used on the Taylor back brace for dorsal or cervical Pott's disease, or to be used on the shoulder piece of the Goldthwait brace for cervical Pott's. It consists of a T-shaped piece of steel, the vertical piece being bent to follow the curve of the neck and back of the head; it should also have impressions on its posterior surface for the set screw which holds it in position; the horizontal piece bent in a U shape so that the ends will project forward along the ears to form arms to support the chin and forehead as on the aluminum brace. There is an aluminum occipital piece made over a cast taken from an impression of the back of the head which is carefully fitted and riveted to the T piece; there are buckles fastened to this piece for the traction straps of the head-sling. There is also a cross piece several inches long with a buckle on each end attached to the upright, opposite the middle of the neck, to which is fastened a collar. (Figure 21.)

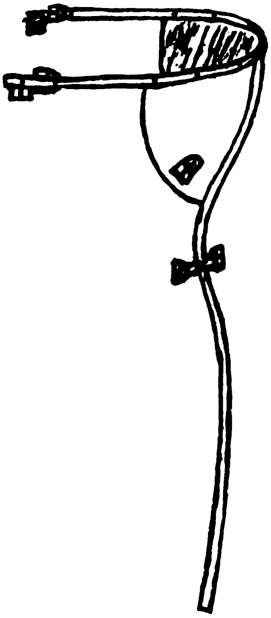


FIG. 21.

In conclusion, I again call your attention to the following important points:

1. The forward tilting and projection of the pelvis through the medium of the abdominal muscles, fascia and ribs an important factor in the production of deformity; the importance of restoring it to its normal attitude and preventing and reducing pain, paral-

ysis, deformity, etc. In cases of Pott's disease in the dorsal, region the increased physiological curves must be reduced to enable us to hyperextend the spine in either of those regions.

2. The characteristic symptoms of cervical and high dorsal cases in the adult.

3. The comparative frequency of Pott's disease in the adult and its difficult early diagnosis.

4. The peculiar manner of taking the X-ray picture and its aid in making an early diagnosis.

5. The special apparatus for holding the patient in a proper position for the application of plaster jacket in Pott's disease below the eighth dorsal.

6. The apparatus used in treating recumbent cases.

7. The special aluminum brace for ambulatory treatment in cases with Pott's disease above the eighth dorsal vertebra.

8. The manner of correcting the original cast, to obtain a pattern for the final brace.

9. Adjustable head-support for use in connection with the Taylor and Goldthwait braces for high Pott's.

IX.

CASE OF CONGENITAL HYPERTROPHY OF LEG.

WILLIAM E. BLODGETT, DETROIT.

Girl, 2 years, 9 months old, through the courtesy of Dr. Max Ballin, Detroit. Father and mother well. No other children, no miscarriages. Normal, full-term pregnancy. Head presentation, delivery by forceps. On third day, mother noticed that the left foot was clubbed and the whole left leg larger than the right. Nothing else abnormal noticed. Breast-fed three months, then bottle fed. First teeth at nine months. Walked at one

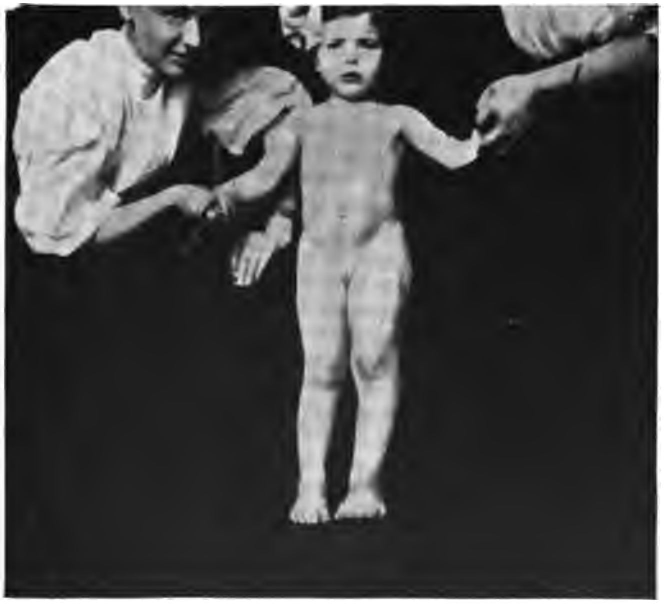


FIG. 1.

year. At first, the left heel in walking was not put to ground, and could not be dorsiflexed to a right angle. Under manipulation by the mother, the equino-varus has much decreased. The relative inequality of the legs, the mother believes, has remained about the same. The child has run about always as freely as any child, and has never had pain in the leg.

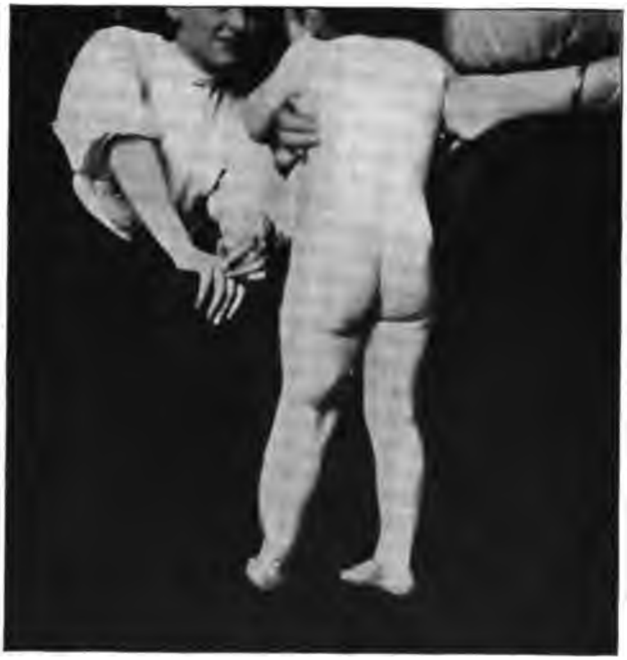


FIG. 2.

Well developed and nourished. Excepting the left leg, examination shows nothing abnormal. Stands with the left side of the pelvis slightly elevated, or the left knee flexed, or the left foot advanced, thus compensating for the increased length of the left leg. No uniform limp, but slight irregularity in walking. Runs and plays about with entire freedom. The whole left leg hypertrophied. The buttock is not involved. Excepting the foot, the left leg is normally shaped, although disproportionately large for the rest of the body, and larger than the other leg. The left foot is broader, especially at the metatarsus, and more compressible. The posterior part of the sole sheers away without any heel eminence; in standing, the back of the sole is kept on the ground most of the time. The toes, especially the small toes, are directed inward as well as forward, and the whole front of the foot is adducted, but the longitudinal arch is obliterated. Good muscle control and power of both legs, and normal active and passive mobility of both feet. Reflexes, and temperature and sensibility of skin of both legs, normal. With the lower leg fully extended, the angle between the femur and the tibia of the hypertrophied leg is slightly less. The shoe used on the hypertrophied side is worn on the outer and back margin of the heel and on the outer side of the sole.

	Left.	Right.
Length leg	42.2 cm.	41.1 cm.
Circ. thigh	31.8 cm.	26.5 cm.
Circ. calf	24.0 cm.	19.5 cm.
Length foot	13.8 cm.	13.1 cm.
Circ. over dorsum	19.5 cm.	16.3 cm.

Radiographs show that the ends of the long bones of the leg share in the hypertrophy. The spaces between the bones of the affected foot appear to be increased. The hypertrophy appears not to involve the pelvic bones.

X.

ATTACHMENT TO BRADFORD FRAME FOR HOLDING HEAD.

WILLIAM E. BLODGETT, DETROIT.

The upright consists of ¼ in. gas-pipe hot-hammered to hold firm the enclosed ends of the wire arms. The lower end of the upright engages in a gas-pipe tee that is inserted in the centre of the head end of the frame. The rest of the head attachment is made of ¼ in. cold-rolled steel wire, as illustrated. The upright reaches to the level of the ears, as the child lies face up. The wire arms are about one inch farther apart than the transverse diameter of the head, and of such a length that the fenestræ are over the ears when the vertex of the head is three or four inches from the upright. The fenestræ are 3½ in. in diameter for a child of three or four years. The entire head attachment is wound thick with sheet-wadding, and bound with strips of cotton; this covering is changed at least once a week. The arms, being made of flexible wire, are readily adjusted, and yet retain the shape

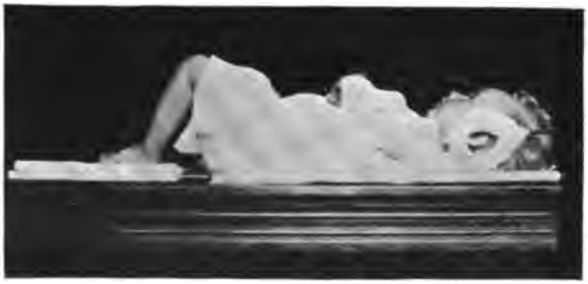


FIG. 1. Acute Tuberculosis of Upper Cervical Spine, under treatment by the Head Support and Bradford frame.

given. The arms are slightly springy, and thus can be made to grasp the head snugly. Setting the head in the apparatus is facilitated by twisting the arms in such a way that the lower margins of the fenestræ are slightly nearer each other than the upper margins. A partly deflated large rubber ring pessary is used for a pillow. The pessary can be deflated by a hypodermic needle thrust through the little block of rubber through which the pessary was originally blown up.

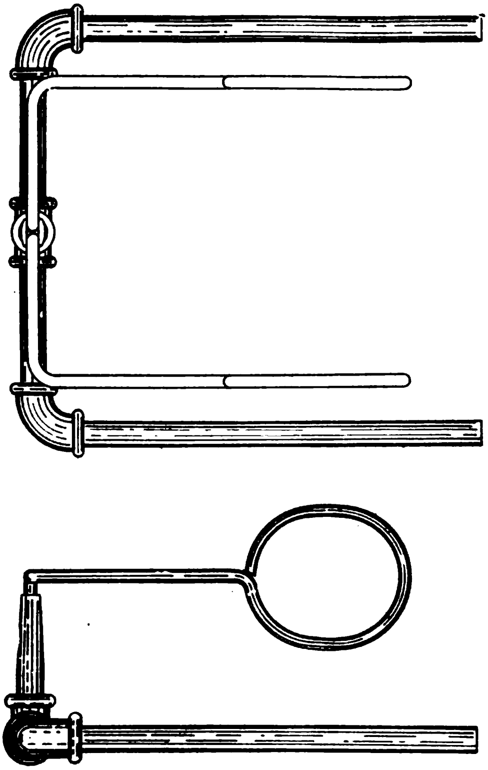


FIG. 2.
Figure is one-fourth actual size.

The device for holding the head is more effectual and lighter than sandbags, and has proved itself useful to the writer in two cases.

ABSTRACTS.

Contribution to the Study of Spina Bifida. By Domenico Taddei. *Arch. di Orthopedia*, 1906, p. 269.

After reviewing the literature, author reports eight cases in detail. Of these seven were operated upon and all recovered; one declined operation. In one case the tumor was the size of an adult head and contained nerve filaments, attached by fibrous threads to the cyst wall, which were loosened and replaced in the spinal canal. Another case was one of spina bifida occulta; there was a bony defect, 1 cm. in size, corresponding to the first sacral vertebra; the tumor was composed of fat and fibrous tissue and three Pacinian corpuscles were observed in the section; there was no cyst nor communication with the intradural space.

In treatment, extirpation is the method of choice. It consists of:—1, Isolation of sac; 2, opening, with reduction or excision of contained nerve elements, and removal of sac; 3, closure of wound. Replacement of nerve tissue is advised when possible. To close the osseous defect, two square musculo-aponeurotic flaps are taken from the muscles on each side and turned in, the superficial surface being placed underneath; in some cases the bones alongside of the cleft may be detached and turned toward the median line. Clefts too large to close by these methods should not be operated upon, as neither should cases which are ulcerated, myelomeningoceles, and cases complicated with serious paralysis and general debility.—*Gwilym G. Davis, Philadelphia.*

Early Recognition of Scoliosis. By Gottstein. *Prager Med. Wochenschr.*, 1905, No. 14. *Abst. Zentralbl. f. Chir.*

As an additional aid in the early recognition of scoliosis, author recommends the determination (with the pelvimeter) of the difference between the diagonals taken from one anterior superior spine to the inferior angle of the opposite scapula. Even in cases of slight curvature a difference between the two is found. In many cases repeated examination and measurement is necessary in order to determine beginning curvature. The fact that severe, incurable cases are still seen is in most cases due, according to author, to the physicians, who do not examine carefully and who make light of the trouble.—*David Silver, Pittsburgh.*

Paralytic Scoliosis. By Nové-Josserand. *Province Méd.*, 1906, No. 16. *Abst. Zentralbl. f. Chir.*

Paralytic scoliosis has the following characteristics:—1, A one-sided curve, compensation being absent because paralysis of the back muscles cannot produce it; 2, a considerable projection of that half of the chest corresponding to the convexity of the curve; 3, absence of rotation; 4, a relatively late appearance of immobilization of the spine. Author does not accept Hoffa's division into static and pure paralytic scoliosis, as it seems to him that there is no especial relation between the location of the paralysis and the direction of the curve; he considers it the result of the disturbance in equilibrium of the trunk and the position of the body associated with it. The strongest point against Hoffa's theory is the irregularity of the scoliosis in bilateral paralysis of the back muscles and the fact that in unilateral paralysis the convexity of the curve is sometimes toward the sound, and sometimes toward the paralyzed, side. Author reports 6 cases.—*David Silver, Pittsburgh.*

A New Corset to Mask the Deformity in Scoliosis with Marked Rib Projection. By Kopits. *Zeit. f. Orth. Chir.*, Band XV, Heft 2–4.

Author uses a corset (model made with patient suspended), of which the posterior part is of hard leather and the anterior of soft material, the shoulders being held with Dollinger steels. In order to give the patient a symmetrical appearance in cases with pronounced projection of the ribs, the leather portion is so constructed as to be in contact with only so much of the back as is absolutely necessary: to accomplish this a double pad of leather, accurately molded to fit the height of the convexity, is used to prevent sinking of the projecting ribs, while the depth of the concavity is bridged over. Description of technic.—*Henry O. Feiss, Cleveland.*

Collection and Analysis of the Reported Cases of Osteoarthritis of the Spine. By Guffy. *Univ. Pa. Med. Bul.*, Nov., 1905.

This paper will prove a valuable aid to anyone making a study of the subject since it contains abstracts of 131 cases, which author has collected "with considerable difficulty." The references are added.—*David Silver, Pittsburgh.*

On Stiff and Painful Shoulders: Subdeltoid or Subacromial Bursitis. By Codman. *Boston M. & S. Jour.*, May 31, 1906.

A valuable and convincing paper, showing that impairment of mobility of the shoulder-joint following injury is, in most cases, due to inflammation or adhesions in the subdeltoid bursa and not in the joint itself; normally the bursa allows the external tuberosity to slide under the acromion, but, when adherent or inflamed, it practically glues the tuberosity to the deltoid muscle and prevents abduction and rotation. Its exposed position renders it very liable to injury; trauma, fixation after operations on, or injury to, the head of the humerus or adjacent structures, and septic infection are the usual causes of subdeltoid bursitis. There are four types:—1. The acute, in which the joint is practically fixed by reflex spasm, only about 10° of painless motion being usually possible (but there is always some motion); the bursa can sometimes be mapped out by the local tenderness. 2. Actual fibrous adhesions, with atrophy of the shoulder muscles; usually painful but sometimes not. 3. In this there is pain with certain motions but actual ability to make all the normal arcs of motion; may be due to synovial fringe or to fold of capsule. 4. Severe traumatic cases, with rupture of supraspinatus tendon. In treatment of acute cases, the sling and such bandages as the Velpeau are to be especially avoided; a heavy wire splint is advised, which goes up the side from trochanter to axilla and then bends outward so as to hold the arm abducted to a right angle with inward rotation, the splint being prolonged to support forearm and hand, and being held by a belt and figure-of-8 bandage around the opposite shoulder. This is worn about a week and then persistent passive motion is begun. Treatment of old cases consists in operation and cutting of adhesions, or the breaking up of the adhesions under an anesthetic, followed by the use of the splint.—*E. W. Ryerson, Chicago.*

Spontaneous Dislocation of the Shoulders.

J. H. Comroe, York, Pa. (*Journal A. M. A.*, March 17), reports the case of a boy, aged 16, who since early childhood had at times been able to produce a subcoracoid dislocation of both shoulders and to replace the joints again in their sockets by painless manipulations. Latterly, however, he had begun to feel some inconvenience and pain in the left shoulder when dislocated, voluntarily or involuntarily, and greater difficulty in repositions. The shoulders presented a characteristically broad, flat appearance from under-developed deltoids and resulting prominence of the acromion process, the humeri were abnormally movable. A fluoroscopic examination showed enlarged capsular ligaments, especially on the left side, the head of the humerus apparently lying in an enlarged pouch of the capsular ligament during voluntary dislocation. On the left side there was a central darkened spot in the fluoroscopic picture, probably due to an inflammatory exudate, which would account for the subjective symptoms complained of by the boy. Comroe finds no similar case in the literature of double, purely spontaneous dislocation. Unilateral spontaneous dislocations of the humerus are not so infrequent and are due to defects of leverage in special movements. He would exclude from this category those dislocations that occur in pathologic joints, as in Charcot's disease. In this case, Comroe advised fixation and rest for the inflamed left shoulder and gentle regulated exercises to improve the muscular and ligamentary tone of the right. General attention to hygiene is indicated in such cases to reinforce the weakened joint. Operative narrowing of the capsule has been successfully resorted to in two persistent cases by Ricard.

Interscapular Arthrodesis in a Case of Myopathic Progressive Atrophy. By V. Putti. *Arch. di Orthopedia*, 1906, p. 319.

Author describes the operation of v. Eiselberg and gives the details of a case in which it was performed by Codavilla. The patient, male, aged 27, could abduct the arm only 40°. The operation consisted in laying bare the posterior borders of the two scapulæ and uniting them with aluminium bronze wire; bony union was secured. The change produced in the direction of the clavicles interfered with the brachial plexus and vessels of the upper extremity, causing pain, weakness, blueness and coldness of the extremity. To remedy this an oblique division of the two clavicles was performed in the middle third, and the parts wired. Following this operation the pains disappeared and the patient was able to raise the affected arm to a right angle with the body.—*Gwilym G. Davis, Philadelphia.*

Treatment of Tuberculosis of Bones and Joints. By Goldthwaite. *Boston M. & S. Jour.*, July 26, 1906.

A short resumé written for the general practitioner. Only such limitation of motion is advocated as is necessary to control the symptoms in the individual case; by moderate use of tuberculous joints the local resistance is increased and healing progresses more rapidly than under complete rest and fixation. The best position for limitation of motion and also for function in case ankylosis results is:—For the knee, 5° of flexion; for the hip, 20° of flexion, 15-20° of abduction, and 10° outward rotation. After operations, such as excision and erasion, the entire operative field should be swabbed out with tincture of iodine to prevent miliary infection. Abscesses should be treated conservatively; if they can be left entirely alone, they will do no harm, but if they interfere with function of some special part, they can be aspirated as often as is necessary; in case aspiration fails, they may be evacuated through a small punctured incision; abscesses infected secondarily should always be opened.—*E. W. Ryerson, Chicago.*

Dislocation of the Hip Following Coxitis in Infants. By Wette. *Zeit. f. Orth Chir.*, Band XV, Heft 2–4.

Attention has again been directed by Drehmann (*Zeit. f. Orth. Chir.*, 1904–5) to those cases of dislocation following acute arthritis in infants, which, he says, cannot be differentiated by clinical symptoms from congenital dislocation. Author reports 3 cases in which the definite history and very instructive radiographs enabled him to make differential diagnosis. The joint inflammations to which reference is made appear usually in the first weeks of life, attacking hip and knee by preference, and show a marked tendency to an anatomical and functional restitution of joint structures; concerning the etiology, there is much uncertainty. In the 3 cases, which are reported in detail, there can be no doubt that pus formation in the joint preceded dislocation. In the first two cause of the coxitis could not be determined, in the third there seemed to have been a furunculosis. The shortening in the third case took place suddenly in the 7th month; it seems that dislocation did not result directly from pus formation but was made possible by distention of the capsule and followed a brisk movement. In the third case the condition was double. Treatment in all cases was that of congenital dislocation. The especially interesting point in these cases was the very instructive radiographs which showed well-formed acetabula instead of the changes characteristic of congenital dislocation. Author concludes that, where the history and other signs fail, the differential diagnosis can be made with reasonable certainty from the radiograph.—*Henry O. Feiss, Cleveland, O.*

Significance of Contracture of the Knee in Cases of Flexion Deformity of the Hip from Severe Coxitis. By Lauenstein. *Zentralbl. f. Chir.*, Oct. 6, 1906.

In neglected cases of coxitis contracture of the knee, reaching an acute angle, may develop in connection with the deformity at the hip, a condition which author has not found mentioned in text-books. This is the result of long-continued activity of the flexors of the knee, associated with relaxation of the extensors. It is often so rigid that it does not yield readily and attempts to correct it, either by extension or plaster, after resection of the hip, may result in fracture of the atrophied femur, since amount of bone removed by resection is not sufficient to permit of correction of contractures of both hip and knee; fracture is always in region of epiphyseal line. Two such cases are reported in detail: attempts to straighten the knee, following resection of the hip, resulted in the first case in bending at the epiphyseal line and in the second in epiphyseal separation. Gradual correction is recommended.—*David Silver, Pittsburgh.*

Cure of Congenital Equino-varus: New Method of Operative Treatment. By Codavilla. *Archivio di Orthopedia*, 1906, p. 245.

While believing that forcible correction is to be the rule, author proposes the following for special cases in which, for various reasons, prolonged and exact care cannot be given. This operation includes opening of all articulations that hinder correction, lengthening of all tendons and muscles that tend to reproduce the deformity, and fixation in a correct position.

Technic. Incision extends from distal end of 1st metatarsal along internal border of foot to malleolus and then up leg. Plantar fascia is divided and tendons of abductor hal., tib. ant., and part of flex. com. dig. are lengthened (Bayer's method). Displacement of these tendons allows access to, and division of, articulations between int. cuneiform and 1st metatarsal and between cuneiform and scaphoid. At this stage manual correction is attempted, Next division of tib, post. permits of opening of Chopart's joint and division of ext. calcaneo-scaphoid ligament, after which correction is again attempted. Other ligaments may be divided, if necessary. The tendo Achillis is divided, also by Beyer's method. While the foot is held in the correct position, the tendons are sutured with fine silkworm gut, except the tendo Achillis, and the foot is enclosed in plaster.

After 4–6 weeks the plaster is removed and an apparatus with elastic traction is applied; this, after a few days, is worn only at night, while during the day the child is encouraged to exercise. Corrective manipulations and massage are practised by the parents for a short time only. After 3 months the children can walk alone in a normal manner.

Twenty-seven operations on 17 children are reported; most of the patients were between 2 and 4 years, some between 1 and 2. Only cases of the second and third degrees were operated. Immediate result in all cases was good, without complication of note; in no case was there a return of deformity; the cicatrix was linear with no tendency to contract; in some cases with exceptional deformity, the foot has remained slightly shortened and a little anterior to its normal position.—*Gwilym G. Davis, Philadelphia.*

Cicatricial Talipes Calcaneus.

The method recommended by Jonas, Omaha (*Journal A. M. A.*, March 31), consists in using a triangular flap so as to cover the affected joint and to extend a considerable distance above it, the resulting V-shaped defect being covered in turn by thick Thiersch flaps. The flap should be long enough and its point should be no lower down than the junction of the lower and middle thirds of the tibia, and it should ensure an elastic covering over the tibiotarsal articulation. When the triangular flap is used for ankle-joint deformities the base line should always extend from one malleolar tip to the other, and it should be flexible and should fall by its own weight over the joint. When possible, of course, the base should be in a central direction, though in both cases reported the reverse was the case. The blood supply seemed to be established in the flap at a very early period and no part of it sloughed. The article is illustrated.

Infantile Cerebral Hemiplegia. By Frankel. *Zeit. f. Chir.*, Band XV, Heft 2–4.

Brief histories of 53 cases from Hoffa's clinic are given and made the basis for an extended consideration of the subject. Author's conclusions are summarized as follows:—All vascular disturbances, occurring during fœtal life, child-birth and extrauterine life, are of importance in the etiology; of these may be mentioned hereditary lues, circulatory disturbances in the fœtus, acute inflammatory circulatory diseases, hemorrhage, embolus, and thrombosis. Prenatal injuries often do not produce their effects until after birth, that is, in connection with birth disturbances and extrauterine ills. The factors which cause Little's disease are of greater importance in cerebral hemiplegia than heretofore believed and difficult delivery, especially delivery with forceps, is regarded by the author as a direct cause of hemiplegia. Acute infectious diseases play a part in the origin of cerebral hemiplegia only in so far as the effect of the toxins is most intense in an already damaged brain in that region most often injured, namely, along the distribution of the median cerebral arteries. On etiological and clinical grounds author considers cerebral hemiplegia as a symptom-complex which always has a vascular origin, and the pathological findings may be explained in accord with his etiological views. The affection is most closely related to cerebral diplegia (Little's disease). The severe deformities of the hand following cerebral hemiplegia may be to-day successfully treated by surgical orthopedic measures, which give good cosmetic and functional results. Tendon plastic in these cases possesses the additional value of relieving the spasm; it not only quiets pre-existing choreic unrest but also prevents the inception of hemiplegic chorea.—*Henry O. Feiss, Cleveland.*

The Course of the Intermuscular Nerve Tracts and Their Influence Upon Tendon Transplantation. By Wollenberg. *Münch. Med. Woch.*, Aug. 28, 1906.

In splitting a tendon and its muscle belly for the purpose of tendon grafting three results are possible:—1, The graft acquires independent function; 2, it contracts only with the rest of the muscle belly; 3, it becomes functionally inactive. The first is uncommon and occurs, according to Lange, only when the tibialis anticus is used; the second is the usual result; the third is fortunately rare. W. contends that the third result is usually due to the fact that in splitting off the muscle graft the nerve connections are severed and so the nerve anastomosis with the intact part of the muscle belly is not sufficient to supply the graft. He shows by carefully prepared injection experiments that some few muscles, as the gracilis and the triceps suræ, have nerves running longitudinally, but that most muscles have nerves running transversely. He concludes,—"The muscle graft will functionate better when the major nerve branches leading into the muscle have been left undisturbed. The graft should not be too small nor should the incision extend higher than the middle of the muscle."—*Walter G. Stern, Cleveland.*

Indications for Tendon Grafting. By Lorenz. *Weiner Med. Wochenschr.*, Jan. 13, 1906.

L. believes the time for a reaction in tendon grafting has come. Indications should be more clearly defined. Transplantation is irrational if it gives rise to a new disturbance in balance in the opposite direction. Nicoladoni's operation was, therefore, irrational, since it favored the development of a secondary paralytic club-foot, a condition worse than the original. Author has had two cases of pes calcaneo-valgus in which this has occurred; also case of spastic pes valgus which was changed by transplantation to varus. At the knee, too, there is danger of transplanting too much and so changing a moderate genu flexum, which produees only slight disability, into the more disabling genu recurvatum. Author gives reasons for opposing transplantation of the flexors into the quadriceps; the biceps and semi-membranosus he believes it is not advisable to use and the remaining muscles are not sufficient, even in the most successful case, to anywhere near replace the quadriceps. Forcible correction of the flexion deformity (by tenotomy, if necessary) and fixation for a time in slight hyperextension have given him satisfactory results. Author insists upon an interval of several months between the correction of deformity and transplantation, and frequently finds that transplantation is then unnecessary. A simple plan of operation is favored, the complicated ones of Vulpius being condemned. In spastic paralysis tenotomy is given the preference. In general, tendon grafting in the lower extremity is regarded as merely an aid to forcible correction, while in the hand, on the contrary, it commands the entire field.—*Walter G. Stern, Cleveland.*

Congenital Osteodysplasia of the Clavicles, Cranium and Teeth.

By Klar. *Zeit. f. Orth. Chir.*, Band XV, Heft 2–4.

In this valuable presentation of the subject, author reports in detail a case presenting above deformities combined with severe scoliosis and gives brief accounts of 37 similar cases collected from the literature. The relative frequency of the various deformities is given. The etiology is considered at length.

By the term "osteodysplasia congenita" is understood a fairly constant combination of bone malformations, as follows:

1. Defective formation or development of all the cranial bones, characterized in the severest cases by complete defect with anencephalus, in the less severe by persistence throughout life of the frontal suture and the anterior, posterior and lateral fontanelles, and in the mildest by depressions at the sites of all the above fontanelles, while the anterior often remains open for some years.
2. Partial or complete of one or (usually) both clavicles.
3. Defective formation of the teeth with persistence of a portion of the milk teeth.
4. High arched, or cleft palate.
5. Striking shortness in height.
6. Kypho-scoliosis.

The cause is assumed to be an abnormal tightness of the amnion; the cases in which the affection is inherited are to be explained by a family tendency to tightness of the amnion, and not in any case, he believes, by fœtal bone disease or embryonic defect. A list of 70 references is given.—*Henry O. Feiss, Cleveland.*

Osteomalacia in Childhood.

By Axhausen. *v. Leuthold-Gedenkschrift*, Bd. II, p. 523, *Abst. Zentralbl. f. Chir.*

A girl, whose family (mother and other relatives), were disposed to fragility and softness of the bones, but who had been well formed and had developed normally, showed in later childhood a tendency to fractures from slight causes. While these healed in good position with the return of complete functional use, there developed later increasing distortion and loss of use—softening of extremities, spinal column and thorax, which now, in her 11th year, is evident both in the changes in form and in the demonstrable yielding of the bones, especially in the wax-like flexibility of the lower legs. During the entire course of the disease the general health has been excellent, nutrition good, there has been no epiphyseal thickening, and the second dentition has developed normally.

Author uses this case, which coincides with the picture of osteomalacia in childhood theoretically constructed by Kassowitz, as the basis for an excellent presentation of the history of this affection; he considers the differential diagnosis from rhachitis, especially from rhachitis tarda; he has collected similar cases, which have been partly described as idiopathic osteopsathyrosis, from the literature.—*David Silver, Pittsburgh.*

Contribution to the Study of Cartilaginous Exostoses of the Epiphyses.

By Fasoli. *Archivio di Orthopedia*, 1906, p. 112.

Such exostoses usually develop during the period of growth and are often multiple; they are to be differentiated from those ossifications that do not pass through the cartilaginous stage. In the case reported, a girl aged 15, a lump was noticed a year previous to operation on the outer and anterior portion of the upper third of the arm; it caused no annoyance nor disturbance of function; at the time of its removal, which was not difficult, it had reached the size of half an apple. Macroscopically it presented as a round mass with protuberances; the surface appeared covered with irregular layers of cartilage; the periosteum was atrophied and in shreds over the growth; at its point of attachment to the humerus, the tumor was composed of compact and spongy bone with yellow marrow; the cartilage, at the points where there was most proliferation and where signs of beginning ossification were present, resembled much a rhachitic process, which has perhaps inclined some to regard the origin as rhachitic. Microscopic examination of this typical specimen showed a disturbed and exaggerated type of normal ossification. Illustrations of 7 microscopic sections are given.—*Gwilym G. Davis, Philadelphia.*

Fracture of the Head of the Radius. By Thomas. *Pa. Med. Jour.*, April, 1906.

T. believes this fracture is more frequent than generally supposed; while he has found only 48 cases in the literature, 55 have occurred in the practice of four radiographers (in Philadelphia).

The probable cause is a fall on the hand in which the angle between forearm and ground is near a right angle, thus transmitting the force to the elbow where it affects the head of the radius chiefly (because the hand articulates practically only with the radius); and, since the anterior part of the head is in contact with the humerus, the brunt of the force is received by it, thus explaining the frequent fracture of this part of the head. Owing to the free rotation of the head during pronation and supination, the fragment will vary its position according to the degree of rotation.

The symptoms are:—Moderate swelling, most marked about radial head; exclusion of other fractures; severe pain and tenderness localized at radial head; limitation of all movements of the elbow, especially pronation and supination; and frequently the history of a fall on the hand; the occurrence of ankylosis later when the splints are removed is pathognomonic in a case which presented the above symptoms.

Union will likely occur in most cases. Since the fracture is usually entirely intracapsular, as a result in every case, where union is complete, apparently serious limitation of motion will be present.

Absolute immobilization for the first 3–4 weeks is favored by author, as he thinks movement during repair will not avail much; it is largely a question of breaking up adhesions afterward. (See also a longer article of same title by Thomas in *Univ. Pa. Med. Bul.*, Sept., 1905).—*David Silver, Pittsburgh.*

Bennett's Fracture.

R. Russ, San Francisco (*Journal A. M. A.*, June 16), calls attention to this fracture, which he believes to be the most common as well as the most important one of the metacarpal bones. It consists, as Bennett has pointed out, in an oblique fracture of the base of the first metacarpal bone in which the palmar half or more of the surface articulating with the trapezium is detached and the shaft of the bone slips upward and backward past this detached fragment simulating a backward dislocation of the thumb. Russ reports eight cases, all observed during the past year, and mostly in the surgical dispensary of the University of California. With this increase of these cases there has been a marked decrease of the diagnosis of thumb sprains and metacarpo-trapezial subluxations. The diagnosis is sometimes very difficult, hence the general impression that this fracture is rare. The first attention may be called to it by a radiogram. Russ discusses the mechanism and reports his cases in detail. In all cases the fracture resulted from a considerable force, usually applied on the distal end of the metacarpal bone, though in one case it was due to injury inflicted on the palmar surface. The diagnosis between this fracture and backward subluxation is important, and Bennett has claimed that a permanent partial displacement is impossible. Russ shows, however, by a case here reported, which illustrates the differential diagnosis, that it does occur. In obscure cases the X-ray must be resorted to, but he thinks that, ordinarily, the diagnosis can be made if care and pains are taken.

Fracture of Base of Fifth Metatarsal Bone by Indirect Violence.

By Brickner. *Am. Jour. Surg.*, Oct., 1906.

B. adds two cases to the literature of this fracture. It was first described by Jones (*Annals Surg.*, 1902); 6 cases have been reported by Cotton (*B. M. & S. Jour.*, 1903 and 1906). Weight of body upon outer edge of inverted foot (when heel is off ground—Jones) appears to be productive of violence. Fracture varies somewhat in location but clinical signs are the same. Of subjective signs, spontaneous pain may be absent and, when present, is variable and not always referred to site of lesion; pain on walking is present but seldom severe. Of physical signs, local tenderness is the essential; pain referred to base when pressure inward is made on distal end of bone is described by Cotton; swelling over outer side of foot is probably always found; ecchymosis may be present; crepitus is reported in but two cases. The radiograph is conclusive but "all lines of fracture cannot be traced quite through bone (in radiograph) but there can be but little doubt that fracture is complete" (Jones).—*David Silver, Pittsburgh.*

Hyperemia Treatment of Congested and Inflamed Tissues. By Bradford. *Boston M. & S. Jour.*, June 14, 1906.

The various methods of producing hyperemia are discussed. Section method is especially applicable to brawny and septically congested tissues; constriction method is better for tuberculous and gonorrhœal joints; active hyperemia is more useful in the comparatively inactive inflammations, such as arthritis nodosa. Author believes that hyperemia deserves a careful investigation and that it will undoubtedly take an assured position in the treatment of certain affections.—*E. W. Ryerson, Chicago.*

Arthritis Deformans and X-rays.

J. M. Anders, J. Daland and G. F. Pfahler, Philadelphia (*Journal A. M. A.*, May 19), report two cases of arthritis deformans successfully treated with the X-ray. The exposures were made three times a week with about 1 milliampere of current for 15 minutes. Internal treatment and massage were also employed. While the report is made as a preliminary one only, the authors say that they consider the method a valuable one, the rays stimulating the metabolism of the affected joints. This should be taken advantage of and massage and passive movement added to assist in the removal of the exudate.

Imperfections of the Radiographic Image.

H. Power, Spokane, Wash. (*Journal A. M. A.*, Sept. 30) reports and illustrates certain experiments performed by him to determine the cause of some imperfections observed in the X-ray image. In one, different portions of the photographic plate were exposed in different ways. In one part the exposure was made in the usual way; another portion was exposed at the same time, but a sheet of lead one-sixteenth of an inch thick was interposed between the object and the target, producing a fainter image, and over another portion of the plate, and in apposition to it, narrow lead strips were interposed. The shadow under the strips was much denser than that under the suspended sheet lead, though the thickness of the lead was the same in each case. The inference, therefore, is that the rays must have passed around and not through the suspended sheet lead. If this be so, three suppositions are possible: 1. The rays may come from some source in the tube remote from the target, i. e., accessory rays. 2. They may have been bent from their normal straight line, i.e., refracted rays. 3. They may have been produced by the action of the well-known rays from the target, i.e., induced rays. That they are not accessory rays he considers proved by the experiment of giving a long exposure to a plate inclosed in a lead box with only a pinhole aperture, and which revealed only the image of the target, or more particularly its central active portion, though other portions of the plate must have been exposed to rays emanating from any other parts of the tube. He concludes, therefore, that the interfering rays in X-ray work are produced in one of the two other ways, and probably by the regular rays inducing new rays.

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I.

A CONSIDERATION OF AN OPERATIVE PROCEDURE TO INCREASE FLEXIBILITY IN CASES OF LATERAL CURVATURE OF THE SPINE.

BY PRESCOTT LE BRETON, M. D., BUFFALO, N. Y.

The general indication underlying the treatment of any deformity is to render the parts flexible to such a degree as will allow correction or overcorrection, and then to keep them in that position until habit or structural changes in the tissues prevent relapse. This indication holds good in the treatment of spinal curvature. All authorities are agreed on the fact that mild flexible cases can be improved or cured, but that the treatment partially or completely fails when there is enough bony or ligamentous change to induce rigidity. Machines for forcible correction are of some value, but in many cases they accomplish but little. The operative measures heretofore devised have had for their aim, a remodeling of the chest, except Sayre's tenotomy and Shaffer's synostosis of the articular processes. Sayre's tenotomy has been abandoned, and Shaffer's operation, which aims to prevent further deformity by an artificial ankylosis, has not been given full trial. Hoffa's rib sections to allow a flattening of the prominent ribs is assuredly on the wrong principle, as it means compression of a lung already in too small a space. Hoke's rib sections to remodel the chest are extensive and severe, and few patients would agree to undergo such a procedure. Experience in treating cases of curvature finally led the writer of this paper to believe that the secret of treatment of the second and perhaps the third class of cases lay in performing an operation which would increase flexibility at the apex of the chief curve, before the usual means of treatment were instituted. The operation, in brief, after study and work in the laboratory and dissection room and on the cadaver of a case of lateral curvature, is as follows: An incision is made over the deep spinal muscles in the apex or angle of the dorsal curve, where there is the greatest resistance to passive motion. A section of muscle about three inches long is removed by cross cuts until three ribs are bared from their angles to the spinous processes. By blunt dissection these ribs are freed from the pleura, and sections removed from each by the Gigli wire from their angles to the beginning of the transverse processes of the vertebræ. The transverse processes are now cleared of muscular and ligamentous fibres by the knife. In doing this, the anterior costo-transverse ligaments are cut, two or more if within reach. The wound is sutured and a plaster corrective jacket put on after some method similar to Lovett's. The jacket can be replaced in a few days by another which will induce further correction. The operation itself can be completed in about thirty minutes and is one that most patients would agree to undergo. It resembles in principle Phelp's operation for club-foot, and in some details it is not unlike Ménard's costo-transversectomy. It has for its object a partial restoration of flexibility, by section of some of the ribs close to the spine, section of a portion of the erector spinæ

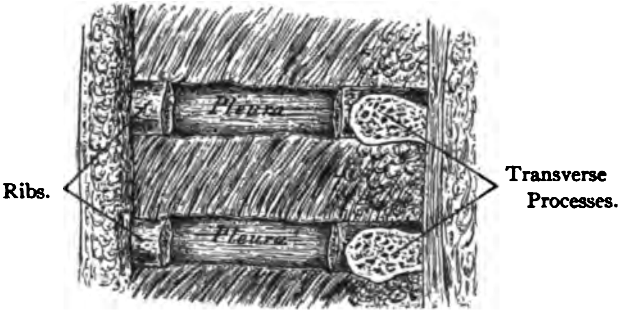

FIG. 1. Diagram, showing that sections of the ribs have been removed, and the transverse processes cleared of fibres.

group in the apex of the curve, and division of several of the ligaments. The writer earnestly hopes that such as are interested in this subject will try this operation on animals and on the cadaver before deciding as to its practicability.

Structures which may be attacked in operation upon a deformed spine. The spinal column, on account of its complexity of parts, has been severely let alone in the past. Certain portions only are accessible. The bodies of the vertebræ, which are far beyond reach, fortunately swing freely in rotation when the posterior part of the column is not too fixed. The posterior arch, with its articular processes, forms a series of bony arches with connecting ligaments which cannot be easily attacked. There remain for consideration the erector spinæ groups, the lateral ligaments, and the ribs. The muscle, if cut at all, must be severed on the concave side, as the opposing group tends, although feebly, to straighten the curve. Myotomy, with retraction of the ends of the muscle, does not give much room for clearing the ribs and the transverse processes. It would seem better to cut out a section of muscle substance as in Arnd's operations on animals. The depression resulting afterwards is of no great consequence. The anterior costo-transverse ligament is a strong obstacle to side bending and is easily divided after resecting the muscle by cut-

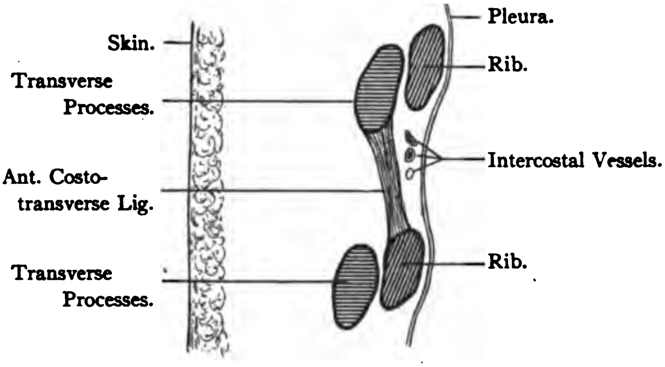

FIG. 2. Cross section, showing position of the anterior costo-transverse ligament and the pleura.

ting away all fibres attached to the transverse process. The thorax is a fairly rigid box or cage chiefly because of the junction of the ribs anteriorly with the sternum. To free the dorsal spine, the ribs must be divided close to the transverse processes. It is impossible in this region to separate from the rib a periosteal covering, so the intercostal muscles must be cut close to the bone. The writer has been unable to find out whether or not regeneration of bone would follow removal of part of the rib in this location. Simple division, without removal of bone, might suffice.

Region which may be attacked in operation upon a deformed spine. It would seem best to limit operative procedures to the dorsal spine between the third and twelfth vertebræ. Cases of curvature at or above the third dorsal are seen rarely. They are difficult to handle in the ordinary way and, therefore, after-treatment would be correspondingly difficult if an operation was performed. Cases of curvature at or below the dorso-lumbar junction are of less importance. The deformity is less evident because there are no ribs to indicate the rotation. The viscera are less affected by the deformity. Furthermore, they are more easily treated by exercises and made flexible. The writer wishes to state that for this class of cases he has found a high shoe on the side opposite the projecting hip of great service. This tilting of the pelvis upward is of value in lessening the rotation, straightening the curve, throwing the centre of gravity down the wedge portions of the vertebral bodies, which then undergo transitions according to Wolff's law. Too little use is made of this simple but most effective agent.

With the hope of finding a practicable scheme for increasing motion in the dorsal region the following experiment was performed on a dead rabbit. (a) In the dorsal region. Excision of a portion of the spinal muscles and of the two ribs underlying from their angles to the transverse processes of the vertebræ. The pleura was uninjured. The ligaments were not cut as they are small and poorly developed in the rabbit. The spine was now found to be more flexible than before and side flexion was increased at that point in both directions. Owing to the elasticity of the tissues in the rabbit, not only was side bending increased when the cut side was put on the stretch, but also when the cut side was flexed, owing to the tendency to collapse of the chest wall. (b) In the lumbar region, a piece of muscle was excised in the same manner and the muscle and ligamentous attachments were freed from two transverse processes, which in the rabbit are large and strong. Side bending with the convexity toward the cut side was markedly increased. In the opposite direction this movement was as much bound as before. This operation was repeated on four live rabbits which were narcotized by morphine. The site of the operation was changed, and the number of ribs which were cut was varied. All these rabbits lived. In no case was the pleura injured although it is very thin in the rabbit. It was evident that the ribs must be divided close to the spine, as in one case in which they were divided at some distance from the spine, there was no gain in freedom. It was plain that severing the erector spinæ alone is of no value, but that the ribs which are the chief binding elements must be cut.

A significant point noted was as follows: Two months after an operation on a rabbit, side flexion of the spine, putting the sound side on the stretch, showed the apex of the curvature and rotation at its usual site, at the lumbo-dorsal junction, whereas side flexion, putting the operated side on the stretch, showed the apex of curvature and rotation opposite the ninth dorsal vertebræ, at the site of operation.

The procedure was repeated a number of times on the cadaver, both in the dorsal and in the lumbar regions. In the lumbar region, section of the muscle and freeing of the transverse processes on one side very greatly increased lateral flexion, but on the living subject the operation would be too severe on account of the size of the wound and the depth of the bone. In the dorsal region the gain was much less, especially as the subjects were adult men and the tissues were hard from prolonged drying in the dissecting room. The bodies of the living rabbit and of the adult cadaver form two extremes when interpreting the results gained by operation. One must recollect that the intact spinal column, from which all muscles and ribs have been removed, has only a limited amount of motion, and that the above procedure could, at best, increase flexibility only within such a range. A number of practical points soon became evident. It was comparatively easy to cut away the muscular fibres from the ribs and to separate the pleura by the use of a knife kept close to the bone and a sharp periosteal elevator. A Gigli wire saw leaves a smooth even end to the severed rib, so that no sharp spicule of bone remains to injure the pleura. In cutting along the upper edge of the transverse process of a vertebra, one has a feeling of safety as the corresponding rib beneath juts above the process about one-eighth of an inch, and the knife, if pushed more deeply, impinges on bone. Likewise, in cutting at the lower edge of the transverse process to sever the anterior costo-transverse ligament, there is little danger, as a distinct cellular interval exists, as may be seen in the diagram, separating the process from the pleura. The intercostal vessels and nerves run in the middle of the space between the transverse processes and are easily avoided. This anterior costo-transverse ligament extends from the upper edge of the neck of one rib to the lower edge of the process above, and is cut most easily at the latter point. To test the strength of one of these ligaments, it was excised entire with bony attachments. Weights were attached by degrees and when thirty-six pounds was reached the ligament separated at its junction with one of the bones. The so-called intertransverse ligament and many strong muscular fibres which limit lateral flexion are also cut in clearing the transverse process. The drawing represents the appearance of the wound after the ribs have been cut and the transverse processes have been cleared. A subject was found in the dissecting room which showed a marked case of lateral curvature, combined with spondylitis deformans. There was ankylosis of the vertebræ and of the vertebræ with the ribs. The apex of the dorsal curve to the right was at the sixth dorsal and the apex of the lumbar curve to the left at the twelfth dorsal. The entire spinal column showed one long kyphosis. The operation was performed in this case in the apex of the dorsal curve without injury to the pleura, but of course with no change in rigidity.

In the general literature of lateral curvature the writer has noticed the following hints as to what might be suggestive as to operative measures: (a) Reginald Sayre, in speaking of lumbar curvature in children, stated, "I have felt in some cases that if I dared to go in there and loosen up the ligaments on one side of the spine, I would be starting in the right direction to remedy the primary curve which I could not reach in any other way." (b) Judson's familiar experiment shows how the anterior portion of the spinal column, consisting of bodies and intervertebral discs is free to move laterally and hence rotate easily in curvature, while the posterior portion consisting of arches, ribs and ligaments is bound. This fact indicates that an operation should aim at freeing the posterior arch, or in other words to cut muscles, ligaments and ribs in such a way as to increase flexibility. (c) Weigel has stated that the keynote of the treatment would be to transfer the pressure of weight from the narrow side of the vertebral body to the thicker side. Of course this cannot be done in a rigid case until flexibility is restored by operation and the parts held in proper relation by plaster-of-Paris. (d) Wullstein's experiments, by which he produced curvature in dogs by keeping them in a deformed position for six months in plaster, proves that after an operation which would restore passive motion to a stiff spinal column, a plaster jacket holding the deformity corrected should bring about adaptive changes in structure. (e) Experiments, as for example, Arnd's, have repeatedly shown that resection of a portion of the erector spinæ in the lumbar region, or of the deep spinal muscles in the dorsal region in animals causes after a few months the development of a typical curvature with bony changes due to the overaction of the muscles on the opposite side of the column. (f) Hoke's statements concerning the importance of the anterior costo-transverse ligaments in preventing side flexion and the increased flexibility resulting from cutting several of these ligaments leads to the inference that they should be cut on the concave side of the curve.

It would seem probable that operative measures for lateral curvature would find a limited field. The case best suited for operation would be a healthy girl about sixteen or eighteen years old, with a fairly marked curvature which shows rigidity and rotation in the dorsal region not yielding to the ordinary treatment.

The flat back should respond more readily to operation and forcible correction than the hollow round back. The writer wishes to acknowledge to Drs. Busch and Gibson of the Buffalo University his thanks for the material and laboratory facilities afforded him.

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II.

MECHANICS OF LATERAL CURVATURE.

Second Paper: Demonstration of Models to Illustrate the Mechanical Tendencies of Posture in the Normal.

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In our first paper it was found that the laws of posture may be resolved into the fundamental laws of equilibration, and that these as they apply to the human form are most easily understood according to the conception of segmental motion. (With regard to segmental motion, although we laid stress upon the shifting of superimposed segments to attain or maintain any given posture, we did not make definite this division of the body into a precise number of segments because such segmentation as is required for movement or posture is not a perfectly formulated separation of the body into parts, for the shifting may take place at a number of variable points, adapting the length of segments to the requirements of a given attitude; for example, if a bend takes place from the pelvis, all the parts above may move as one segment if they are held rigid, but if additional bends take place in the neck and lumbar region the parts above the pelvis move as several segments. In the same way there may be a bend at the neck with rigidity of all the body beneath, or the neck might bend with an accompanying motion of the thorax or pelvis or both, so that the sharp limitation or the exact counting of the number of segments in the human body in the present connection must necessarily be impracticable, although the principle of motion must answer to this conception.) Such motion must apply to the skeleton alone but the totality of body form in any posture is established by the envelope of soft parts which rounds off the contours and exerts passive resistance upon the separated bony segments, as a result of which the skeletal parts are often under strain.

We further found that the thorax may be regarded as one of these segments and moving as a unit, either in combination or alone. This motion we referred to as primary and in this light the dorsal spine is to be regarded as an integral part of the thorax and moving as such.

Then we showed that active movements of the thorax must imply tension of one or more of its walls, and the effect of such tension must be to place the ribs under strain, tending to change their shape and their direction.

Finally we attempted to explain on a deductive basis how the strain brought to bear on the ribs is conveyed back through their attachments into the dorsal column, and that the tendency of this must be to divert the vertebræ in accordance therewith, which tendency, as compared with the primary dorsal movement, must be regarded as a separate one of reaction.

To demonstrate more clearly our conception of these tendencies we have had mechanical models constructed. Regarded as evidence in favor of any theory they have little value, but we use them, not to prove but to illustrate, and if they do this we will feel satisfied that the purpose of their construction is answered.

These models were made by Mr. George H. Mickey, of Cleveland, and represent not merely a fine mechanical skill, but intelligent and deliberate thought during the act of construction. We take this opportunity of expressing our deep thanks for the work.

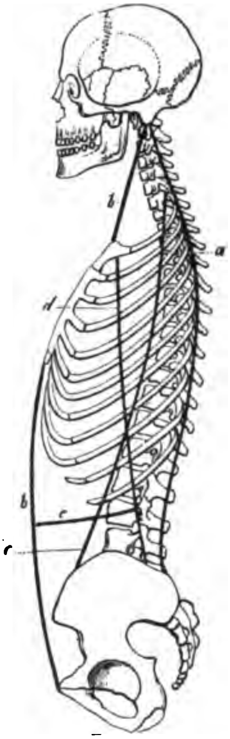

FIG. 1. G. Herman Meyer. The scheme of the torso musculature indicating the direction of the various muscle pulls. *a*, Posterior longitudinal muscle pull (*m*, sacrospinalis); *b*, anterior longitudinal muscle pull; *c*, oblique descending muscle pull; *d*, oblique ascending muscle pull; *e*, transverse muscle pull.

It will be remembered in our previous report that we laid stress upon the manner of regarding the muscles, for if the greater part of what we stated was based upon truth they must be looked upon as functionating in two distinct mechanical ways, in the first place as conveyors of motion, and in the second place as passive factors of resistance. It is this latter function that we emphasize, although in this capacity they are not alone but simply part of the whole human machine, resembling more closely the fasciæ, ligaments and integument, but for the sake of simplicity it is only necessary to confine ourselves to the muscular system, for the other passive factors of resistance in any localized situation are closely interwoven therewith. We have already shown the peculiar

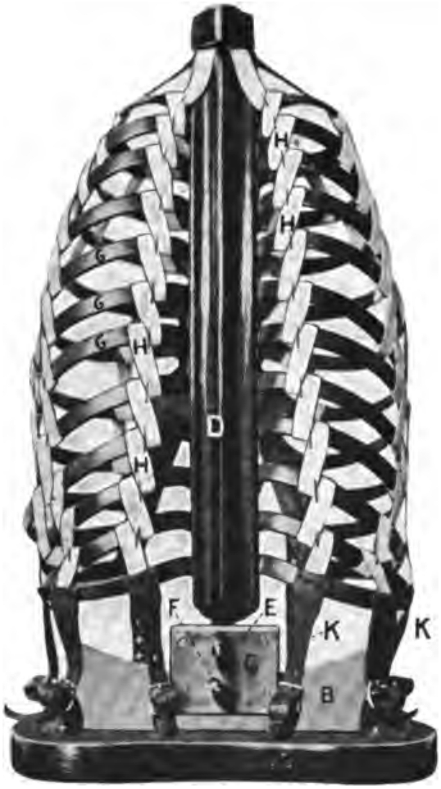

FIG. 2. Model of thorax, seen from behind. A, base; B, metal arc; C, block, gliding on arc; D, stave representing the dorsal column; E, set-screw fixing the ball and socket joint of dorsal column in block; F, set-screw fixing block to arc; GG, leather ribs; HH, tapes representing muscles; KK, adjustable leather straps.

import of the trunk muscles and the aptness of Meyer's division in connection with this subject and therefore use his system (Fig. 1) as a guide.

MODEL OF THORAX.

This (Figs. 2 and 3) consists of a base (A) representing a fixed basic resistance (either a fixed pelvis or the floor). On this is set an arc (B) made of metal, on which there glides a block (C); this block supports a curved stave of wood (D) made to simulate the shape of the dorsal spinal column. The connection between the block and the column is a ball and socket joint. This permits universal movement of the column upon the block in any position in which the latter is placed. There are two set-screws, one (E)

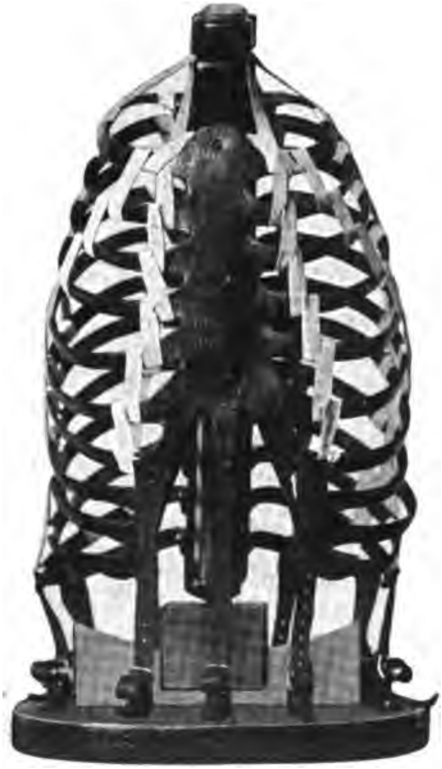

FIG. 3. Model of thorax, seen from in front.

fixing the ball and socket joint and the other (F) fixing the gliding block to any part of the arc so that either one of the joints may be used without the other. From the dorsal column there branch out on each side twelve ribs (GG) made of sole leather and running into a leather sternum in front. Each rib has two attachments to the column, one to that part of the stave representing the row of bodies, and one to that part representing the row of arches, thus imitating nature. The general relations and attachments are also designed to simulate the normal thorax.

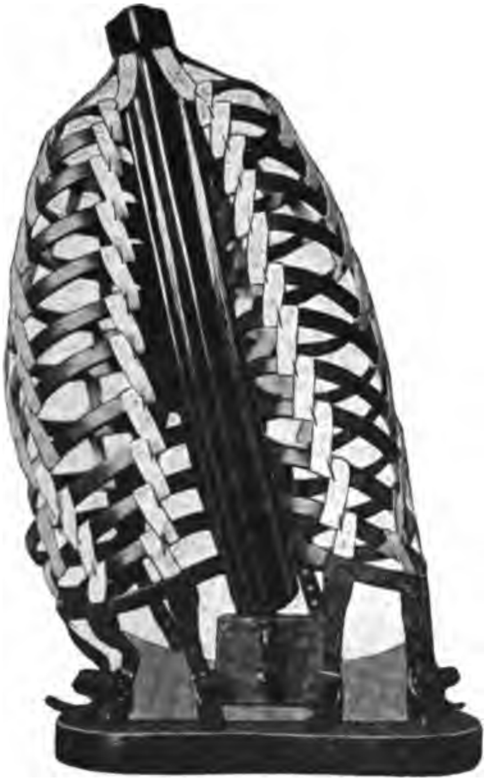

FIG. 4. Model of thorax. Pure side bend.

Now using as a guide the diagram of Meyer which we mentioned, we attach tapes (HH) representing the muscular pulls as seen on his diagram. We have represented the longitudinal spinal muscles, the external and internal obliques, the two recti, and the linea alba. (For purposes of simplicity we omit the transversalis.) These muscles, as we showed before, may be represented by a pull running from the walls of the thorax down to the pelvis. As to the nature of the application of each, we have simply passed the tapes from the upper attachments down the thoracic walls, fastening them to the ribs as they go down. These tapes are continued from the last ribs as soft leather straps (KK) which may be buckled to the proper degree of tightness at the base. So, a pull of any portion of the tapes is continued through the leather straps to meet its final resistance in the base. This sort of a thorax we have made to illustrate what we believe are the principal mechanical factors in the living. There is one hypothetical exception, the elasticity of the ribs. By using leather ribs instead of bone ribs we may trace out, in an exaggerated way, the path which the distortion would take and by means of such exaggeration hope to make clear what we believe the normal tendency is in the thorax. The stiff dorsal spine without any intervertebral joints is necessary to illustrate what we mean by total segmental movement of the thorax. In this way we are able to rule out all possibility of distortion in any other part than the rib wall. In other words, other things being equal, we hope to illustrate what effect total segmental movement of the thorax has upon a flexible rib wall under conditions of parietal resistance, resembling that of the normal tube of soft parts.

The first movement we deal with is lateral flexion. (Fig. 4.) To gain this the block is fixed to the center of the arc and the dorsal column bent to the side at the ball and socket joint which here is the center of motion. The immediate effect is a relaxation of the straps on the side towards which the column is bent and a tightening of the straps on the opposite side. The effect of this tightening is to compress the rib wall, to narrow that side of the thorax, sharpening the posterior convexities of those ribs, and causing them to descend.

The next position (Fig. 5) is one which more closely simulates the usual lateral bend, namely, a pendulum movement of the thorax, its base swinging to the right and its apex to the left, for unless the pelvis is fixed, this is the position of normal side bending because it balances this segment over the base of support and so permits an easier equilibrium. (See previous report.) In the model this position is obtained by releasing both set-screws and sliding the block to the right on the arc, the arc representing no particular motion but simply the type of motion. (In this case the center of motion is a movable one and located, of course, above the arc.) The effect is the same as the previous one with the single difference that in the present position distortion is more pronounced, so that for practical purposes in side bending, whether the base swings or not, the illustrations are alike, namely, on the convex side of the bend an approximation of the vertebral column

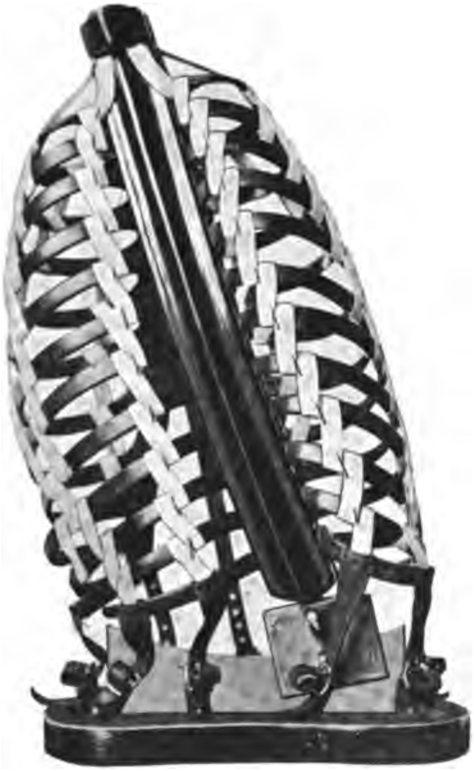

FIG. 5. Model of thorax. Side bend with base swinging on the arc.

to the lateral resistances, a narrowing of the thorax, a descent of the ribs, and a sharpening of their posterior curves, while on the other side we find marked relaxation.

The position of twist (Fig. 6) is gained by tightening the block on the arc and rotating the column on the ball and socket joint. The kyphotic curve of the column now becomes a lateral curve.

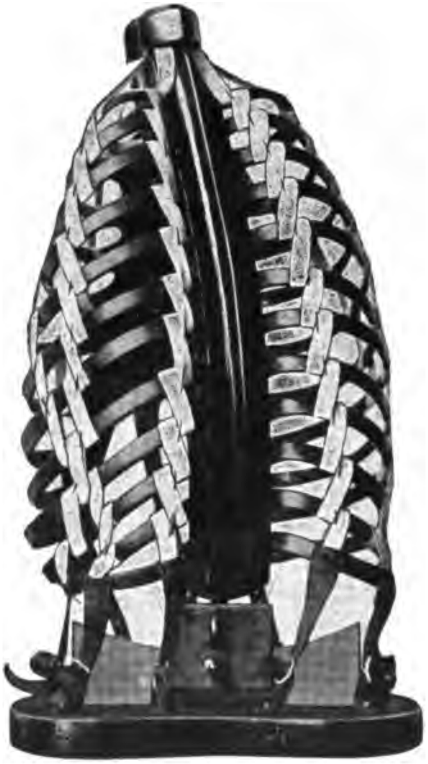

FIG. 6. Model of thorax. Twist.

A whirling arrangement of the muscle straps is shown very plainly, the anterior ones being directed obliquely in an opposite direction to the posterior ones and the same opposition being noticeable in the lateral straps. This shows that the basic portion of the thoracic wall may be rendered taut by the spiral pull. In the ribs there is little change of shape, the chief change being a flattening of the lower ribs on the concave side of the lateral bend of the column. But distortion is in no way marked. The difference between this and a lateral bend is that in twisting the column the tension is conveyed uniformly through the base and the effect is widely distributed throughout the thorax, while in a lateral bend the tension on the side of the convexity has a direct effect soon after the beginning of motion. As is to be expected, if we add to the twist any amount of lateral bend (Fig. 7) the effect of the lateral bend immediately becomes noticeable.

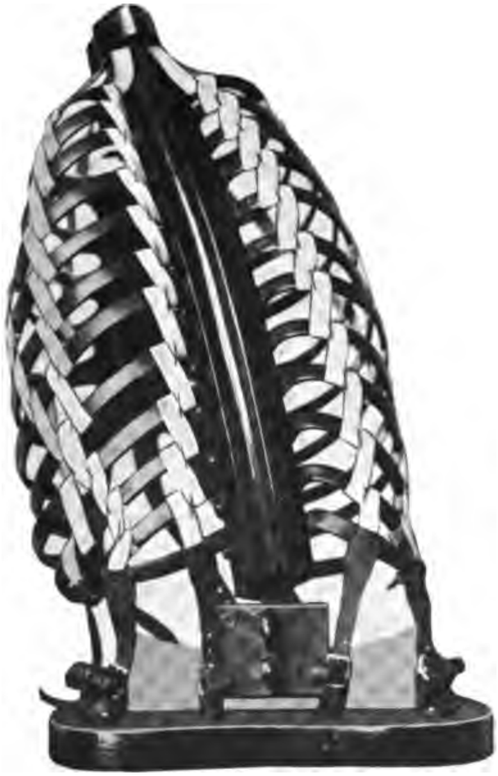

FIG. 7. Model of thorax. Twist, with side bend.

So the chief points illustrated in this model are, first, that with segmental motion of the thorax and with tissue resistances on the lateral walls, distortion will take place in the rib walls if there is any elasticity present; second, that lateral bend has a direct tendency to distort them, and that twist has a less direct tendency to do so, probably on account of the more uniform strain through the base of the thorax.

MODEL OF VERTEBRA AND RIB.

In the previous model we only illustrated our views up to a certain point, ruling out all possibility of effect beyond that of rib distortion. The thing which we now have to illustrate is, what tendency, if any, rib distortion may lead to in the individual vertebra.

We found earlier that in spite of the propensity to total thoracic movement which is to be regarded as the primary motion, there may, nevertheless, be inherent possibility of motion between separate dorsal vertebræ, the nature of their motion being probably a rotatory one. (It will be noted that if we so often refer to a dorsal spine moving in conjunction with a unified thorax we cannot refer to a movement between separate dorsal vertebræ without seeming to contradict ourselves. In explanation we repeat what we stated earlier, that when we refer to a dorsal spine and its segmental motion we mean a practical condition, or, better, its motion regarded as relative to that of other parts of the body, so that the possibility of individual vertebral movement is perfectly consistent as taking place apart from the primary movement of the thorax.) Yet, even if we suppose that there is absolutely no movement between dorsal vertebræ in nature we may in our model apply a hypothetical amount of mobility for the simple purpose of demonstrating the tendencies under given conditions, but this model is made not so much to illustrate a vertebra and a rib as the relations between parts and the nature of the forces and the resistances brought to bear in a cross section of the thorax under conditions of normal posture.

We have to do, in the first place, with a rib ring, the interruption of the sternum being for theoretical purposes eliminated. The rib ring meets behind by means of the vertebral column, this interruption being afforded by the kidney-like shaping of the rib ring, for in nature the rib ends, instead of meeting, run almost parallel to each other to their respective attachments on each side of the vertebræ.

Our model (Fig. 8) consists of a solid base (A) with a white strip (B) to denote its median. Upon this base there glides a wooden vertebral segment (C) faced with metal. This is prolonged into an arrow (D) to indicate the direction in which the vertebra points. To the posterior part of the body and the transverse processes of the vertebra is attached a leather ring (E) in the manner described above. To carry out the principle of segmental motion we use a steel axis (F) to represent the primary radius and have attached the vertebra to it by means of a pivot (unseen in figure). Then by using a retaining peg (G) which fits into a steel arc (H) belonging to the vertebra, the two axes, the vertebral and the primary, may be rendered one if we pass the peg through the central hole of the vertebral arc as seen in Fig. 8. In this way the

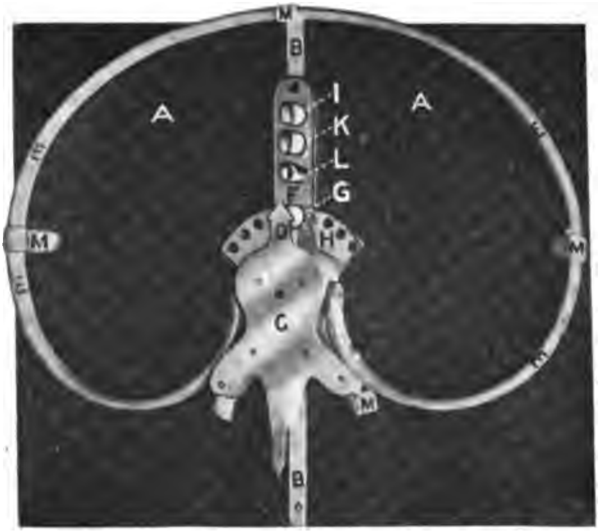

FIG. 8. Model of vertebra and rib. A, base; B, median strip; C, vertebra; D, arrow, indicating direction in which the vertebra points; E, leather rib; F, steel axis on which vertebra is pivoted; G, retaining peg, holding arc of vertebra to steel axis; H, metal arc fastened to base of vertebra; I K, fixation pegs passing through steel axis into base; MM, elastic tapes representing the muscles.

vertebral motion may be made part of the primary segmental motion; but by removing the retaining peg the vertebra is permitted to revolve on its own axis. By means of two fixation pegs (I K) which pass through holes in the steel primary and fit into holes in the base, we can fix this axis in a number of asymmetrical positions. A handle (L) enables easier manipulation. Our muscular resistances are represented by elastic tapes (MM), an anterior elastic representing the linea alba and the recti, two lateral elastics representing the oblique muscles, one on each side, and two posterior elastics representing the posterior spinal muscles.

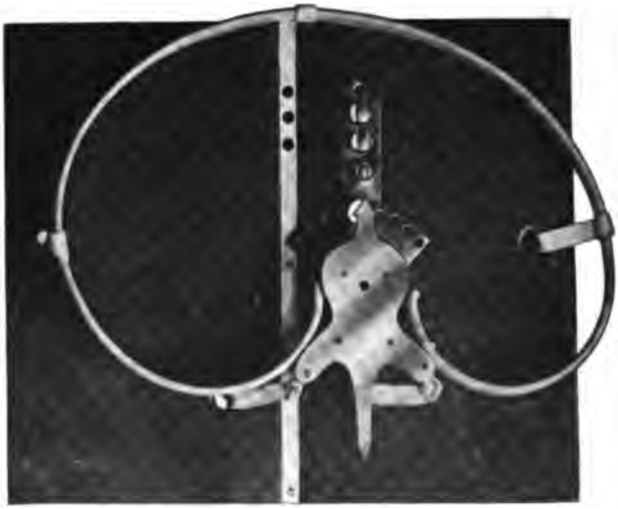

FIG. 9. Model of vertebra and rib. Side bend, the retaining peg in place.

Taking first the pure lateral bend to the left, then the total segment of the thorax would either make a pendulum motion, so that the apex would go to the left and the base to the right, or the whole thorax would swing to the left as shown in the previous model. In either case the important point is the approximation of the convex rib wall to the column. We now obtain a position analogous to that seen in Fig. 5 which we believe illustrates the characteristic type. With the retaining peg in place at the center of the vertebral arc we pass the steel axis laterally to the right and apply the two fixation pegs to hold it in its position. (Fig. 9.) This brings about a tension in the elastics on the right. The result is, of course, a distortion corresponding to that in the previous model (Fig. 5), an approximation of the vertebra to the side wall on the right, with narrowing of the area between, and posterior arching of the rib. (To demonstrate a position analogous to a pure side bend as in Fig. 4, it would be necessary, instead of passing the primary axis to the right, to compress the right rib wall by pulling the right elastic towards the left, which would, of course, bring about practically the same effect as the above, but with the vertebra and rib ring in a different position on the base. But this would require clumsy illustration, and as it is not the position of usual lateral bend and the effect is so similar to the other it will not be necessary to dwell longer on this phase.)

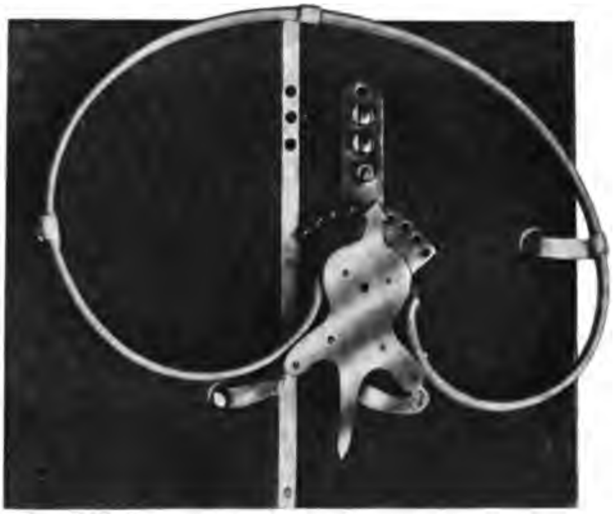

FIG. 10. Model of vertebra and rib. Side bend, retaining peg removed.

The next step is to release the vertebra so it has the power to gain a new equilibrium, providing there is any potential energy in the distorted rib wall. To demonstrate this (Fig. 10) we remove the retaining peg, releasing the vertebra, and immediately the arrow diverts from the axis of primary motion, or what is more important, the arrow diverts toward the side on which the rib is the more convex posteriorly, namely, in this case towards the right.

Now taking the twist, first placing the vertebra so that its arrow points in a line with the primary axis and with the retaining peg in place to hold it there, then by twisting the axis on one fixation peg in the median line, and applying the other after it is twisted, we have in this way been able to divert the primary axis and the vertebra as one piece (see Fig. 11), and this illustrates the position of the vertebra when regarded as moving as part of the segmental motion of the twisting thorax. We recognize that the condition of the rib ring so far as shape goes corresponds to that of the total thorax in the previous model here seen in horizontal section, for all we have done is simply to have moved the whole thing, vertebra and ribs attached, as one piece. It is also to be noted that all the elastics are under tension in a peculiarly spiral manner and that this tension does not affect the shape of the rib ring beyond a moderate degree, owing to the distribution of the pull. This is in marked contradistinction to that effect noticed in the first position of lateral bend (Fig. 9).

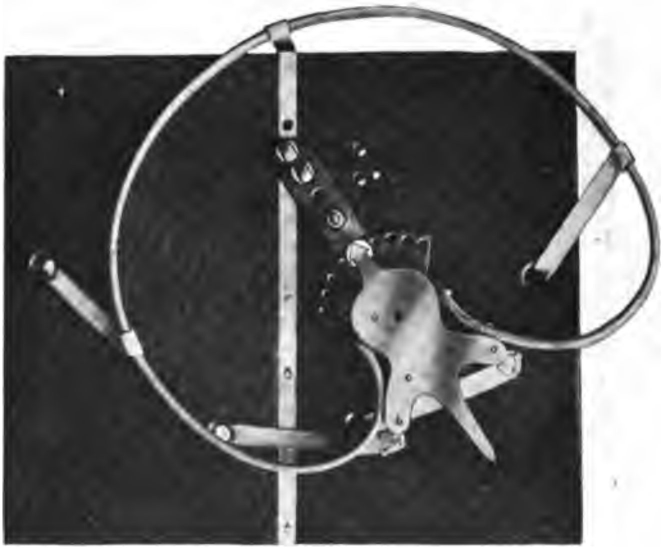

FIG. 11. Model of vertebra and rib. Twist, retaining peg in place.

To demonstrate the final tendency, the next step (Fig. 12) is to remove the retaining peg from the arc of the vertebra so that it may move on its own axis if it has such a tendency. The effect is marked, for immediately the arrow diverts a good part of the arc to the right. This permits the right rib to obtain a great sharpening posteriorly compared to that of the left, and the tension on the elastic straps is diminished or disappears entirely, showing that the whole machine has gained a new equilibrium. It is very interesting to note that this final position corresponds very closely to the final position of the lateral bend, although the primary axes are in different positions (compare Fig. 10 with Fig. 12). That is to say, the shape of the rib and the direction in which the vertebræ are pointing with reference to the median line of the base are practically alike in the two. We must also add here, although it is not necessary to illustrate the point, that we have taken the primary axis and placed its center of motion behind the vertebra instead of in front, then we moved the vertebra to the right and released it again after the manner of the previous illustration and we again could obtain a similar position to that of the final position of lateral bend or twist. In the same way we placed the center

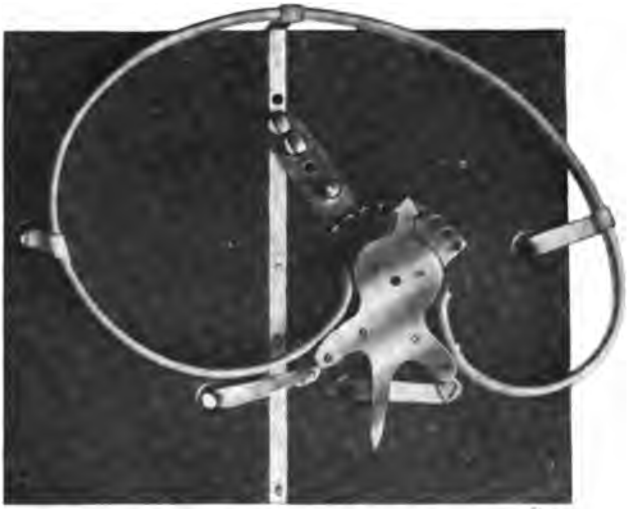

FIG. 12. Model of vertebra and rib. Twist, retaining peg removed.

at other points which permitted us to get the same result, the point of the arrow always diverting toward that side on which the rib becomes more convex posteriorly. (It is also to be noted that the arrow may point in a direction which diverts from the median line one way while it diverts from the primary in the opposite way. For example, we may place the primary axis in such a position that the arrow will point to its left while it may still point toward the right of the direction of the median line, but the law which it follows is with reference to the direction of the median line.) In short, if the vertebra is allowed to rotate freely, its direction and the shape of the ribs attached are practically the same by whatever path its center reaches a certain point, the final position being simply one of equilibrium. This fact explains how immaterial it is to decide on a fixed position for the center of motion of the thoracic segment, the important point being to discriminate from such primary segmental motion and any movement which might possibly take place in an individual vertebra.

Of course it can readily be understood that the cause of the mechanical alterations observed in the position of final equilibrium is principally in the parietal resistances but they are influenced also to a marked degree by the peculiar relation of the vertebral ends of the ribs to the posterior part of the vertebra; however, the ultimate distortion is not the result of any one thing but is the result of the sum of all these conditions, namely, the relation of parts, the attachment of the pulls, and the elasticity of the ribs. Therefore, the chief points illustrated in this model are, first, that in asymmetrical movements, a dorsal vertebra will tend to move upon its own axis, which is entirely distinct from the axis of motion of the thoracic segment; second, that the vertebral axis will tend to divert (from the direction of the median line of the base) toward the side on which the posterior curve of the rib presents the greater convexity; and third, that the factors which control these tendencies, namely, the parietal resistances of the rib ring, the peculiar relation of the ends of the ribs to the back part of the vertebra and the elasticity of the ribs, are fixed quantities so that the path tending to any given final distortion may be one of several.

So we have illustrated what we believe are the laws of the normal tendencies in the thorax. The quality and quantity of motion existing between separate vertebræ are points which are difficult to demonstrate definitely in nature. That there is a normal amount of movability, chiefly rotatory and perhaps lateral, there can be no question, and while we cannot analyze this motion accurately the effect of the tendencies under the conditions of strain illustrated must be practically the same. But even if there were not the slightest movability between the vertebræ of the dorsal column and no effect could be obtained in the normal, the illustrations of the forces would still hold good, and we will later attempt to show that with such forces, active under given conditions of strain and fixation, any permanent distorting effect must follow the laws of the normal tendencies.

III.

THE TREATMENT OF LATERAL CURVATURE OF THE SPINE; RESULTS.

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The subject of lateral curvature is a very complex one and the study of the etiology and pathology still more so. In the present paper, only treatment is to be considered, which in itself, is a subject of great magnitude.

On first beginning orthopedic work an occasional case of curvature would come for treatment and at that time many and varied exercises were used. Many of the mechanical contrivances which were described in the journals were utilized as auxiliary to the gymnastics and the exercises themselves were of all kinds, side bendings and nonsymmetrical, as well as symmetrical. The results were far from satisfactory.

A little later, on becoming a member of this association and hearing a discussion on this very subject, it was evident that others were experiencing much difficulty with such cases and I remember getting a great deal of comfort from the remarks made by the late Dr. Phelps, that he had been abroad and visited the clinics there and found that they were all doing just the same thing as the Americans; i.e., they all *claimed* to make such cases perfectly straight, but that they really didn't do any such thing. In consequence of this, as the years went by, one thing after another was eliminated, while the carefulness and precision of the remaining methods were more rigidly insisted upon, and with each change there was apparently an improvement in results. With such improvement my spirits gradually rose until at present I am really enthusiastic regarding results. Of course, if one expects impossible things, disappointment is sure to follow, but it seems as if each year more and more could be expected as a direct result of improvements in treatment.

In classifying cases of lateral curvature much excellent work has been done and you are familiar with Dr. Lovett's classification, but as regards treatment alone, I simply consider whether the spine is flexible or rigid and whether there is much rotation. In other words, whether with or without rotation is the spine flexible enough, and (a *very important* consideration) does it give promise, in some fairly rigid cases, of becoming flexible enough under treatment to warrant following the purely gymnastic treatment, or does it require, for a time, forcible correction. By forcible correction is meant placing the patient in a frame, then by padded disks and plunging rods, to so make pressure on the various projecting points, that some of the deformity is corrected. Then while the patient is held in this corrected position, plaster-of-Paris is applied and allowed to set. There are all gradations in severity of cases. One may be considerably deformed and have considerable rotation and yet be flexible enough to do exceedingly well with exercises alone. Another may not be so badly deformed but the spine may be very rigid and need forcible correction for

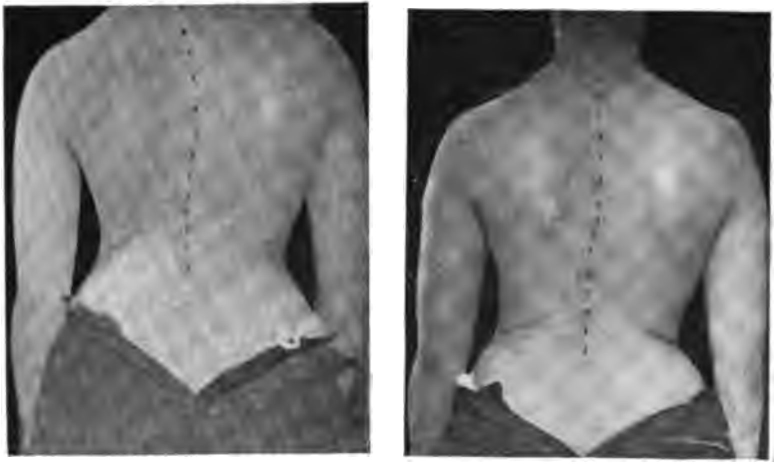

FIG. 1. Young lady, age 20 years. Duration of treatment, one year.

some months and this followed by much harder work (exercises) than a more deformed case, but one which was flexible. With increasing experience, the rigidity and amount of rotation seem to determine whether or not forcible correction should be used for some time preceding the beginning of exercises. Very difficult cases are those where the upper dorsal vertebræ are rotated, the ribs beneath the scapula projecting backwards so that that particular scapula is very prominent.

From the clinical point of view, there is another element, i.e., prognosis, one in which the parents are intensely interested and upon which may hang their permission to submit to treatment. Again is it difficult to be *certain* of the results, for very mild cases may persist in spite of the most careful treatment, and deformities which are rigid and appear very unpromising may improve very materially.

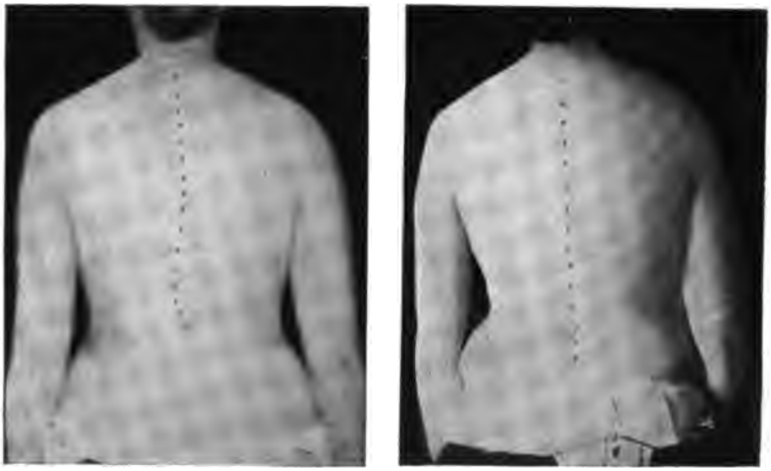

FIG. 2. Young lady, age 20 years; photographs show one year of treatment.

A case illustrating the latter conditions was that of an Armenian boy, aged fifteen or sixteen years, who applied to the hospital clinic with a marked curvature with rotation and a very prominent right scapula. It did not seem as if much impression could be made upon his condition. The boy happened to be very ambitious, and although very little attention was given to the supervision of his exercises, except to add new ones slowly (they were all symmetrical, however) he worked like a Trojan and the improvement was so surprising and so unexpected that this very case has given me encouragement in treating difficult ones since.

As indicated above, the treatment may be practically considered under two heads, gymnastic and mechanical.

I. GYMNASTIC.

Gymnastic exercises have been used for the treatment of lateral curvature from the earliest times, but they have been of all kinds and used very indiscriminately and apparently many of these were persisted in even though doing much harm. Also exercises have been used in connection with mechanical devices of many kinds, these mechanical affairs being used, some with the patient laying down, others with the patients standing. As indicated above, in early practice all of these varied exercises and many of the mechanical devices were used.

First the mechanical devises were gradually dropped, then the exercises were taken in hand and one after the other excluded. During this process of elimination it became very evident that the tendency was to hold to the symmetrical movements and do away with the asymmetrical ones. At present that basis, with an occasional exception, is very firmly adhered to. There are some symmetrical exercise or exercises for each individual case, the doing of which, in a proper manner, forces the *whole length* of the spine into a *straighter* position in severe cases and an actually *straight* position in the mild ones.

The movements which really accomplish this result in any case are the ones selected to be continued day after day for a long time. In practically every case it seems impossible for the patient, while standing, to hold the body and spine in a very much corrected position long enough to do very much in the way of exercises, consequently the beginning is always made with the subject lying on the table, because it is a well-known fact that when lying face down on the table the body and spine naturally (by gravity) assume a much straighter position than in any other way. Begin-

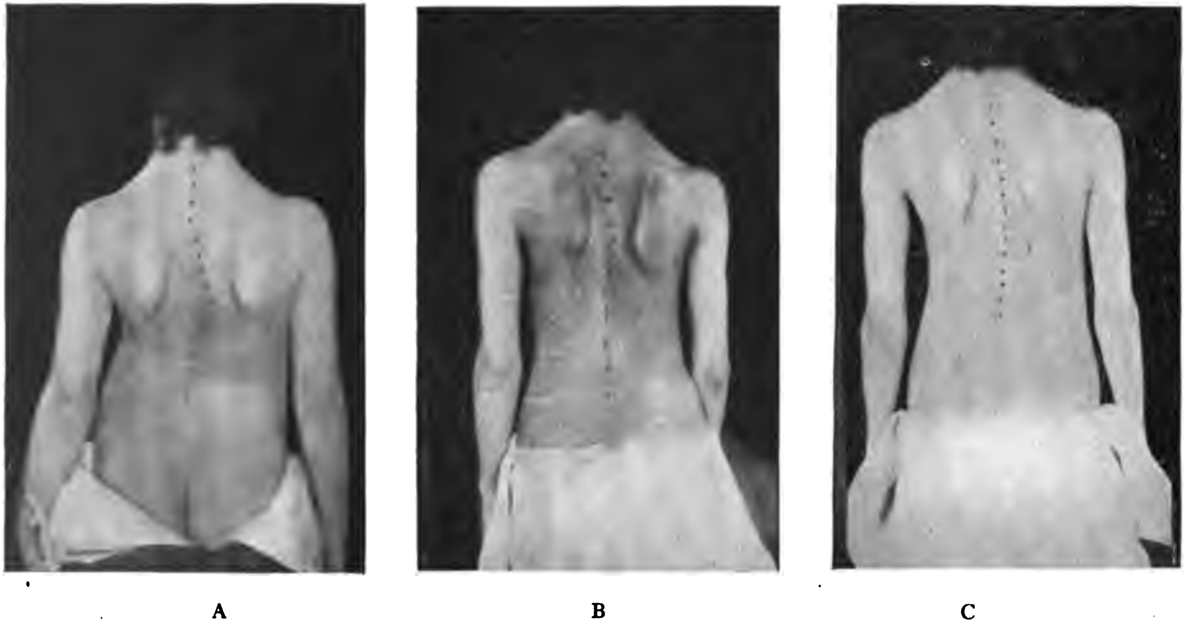

Fig. 3. A girl, age 11 years. A very rigid spine and forcible correction with successive jackets for 1½ years between A and B. C shows present condition with three months of gymnastics since omitting jacket.

ning with this position, such movements are continued for a considerable length of time and until the muscles and the muscular sense are sufficiently developed before doing any work in the standing position. It is also evident in almost every case that when the change is made from lying down to the standing position, the education of the sense of standing in the straight position, or of a more corrected position, has to be practically begun again. Even after a prolonged training, the ability to hold the spine in a satisfactory position is very difficult. In consequence of this difficulty a long time is spent on the exercises in the lying down, and next, in the sitting position before any attempt is made with the standing exercises.

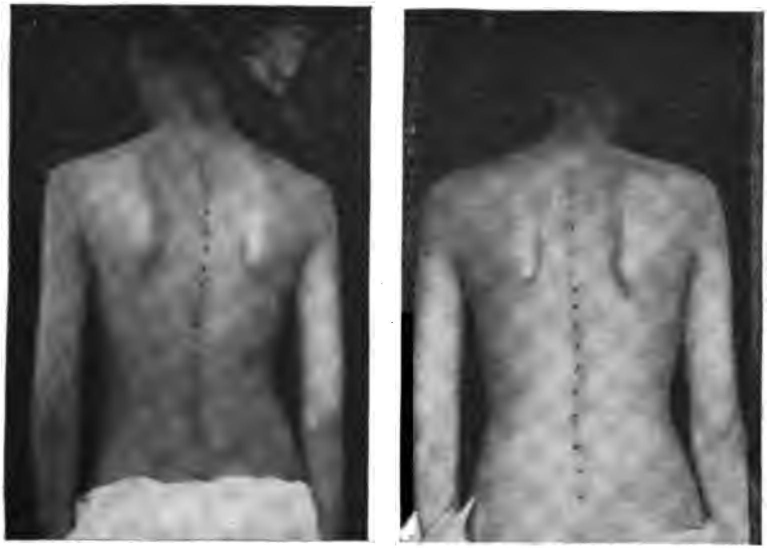

FIG. 4. A girl, age 12 years, eight months of gymnastics.

As indicated above, there has been a gradual elimination of exercises until nothing but perfectly symmetrical ones are left. Always first are the ones given with the subject lying face down on the table. The children are taught to voluntarily assume a position which is either much straighter than the one they would naturally assume, or, in the mild cases, it may be perfectly straight as far as can be judged by the eye alone. While the body is held in this corrected position some exercises are given. Each individual is given the movements and instructions *alone* so that the whole and undivided attention of the supervisor can be directed to the work. If done correctly, this means hard work to the supervisor. The general position of the body and spine must be kept up as nearly perfect as may be possible, in each individual case. This calls for *constant* coaching and *continual* suggestion all the way through the session, thus keeping the child on the *qui vive*, mentally. Also the separate movements must be kept up to perfect precision by the same method, thus the child's mental alertness, muscular sense (or sense of knowing whether the body is held straight or not) and physical development are all improved together. It is the nice precision of holding the body in its corrected position and the doing the particular movement with perfect accuracy that makes ordinarily easy exercises very difficult.

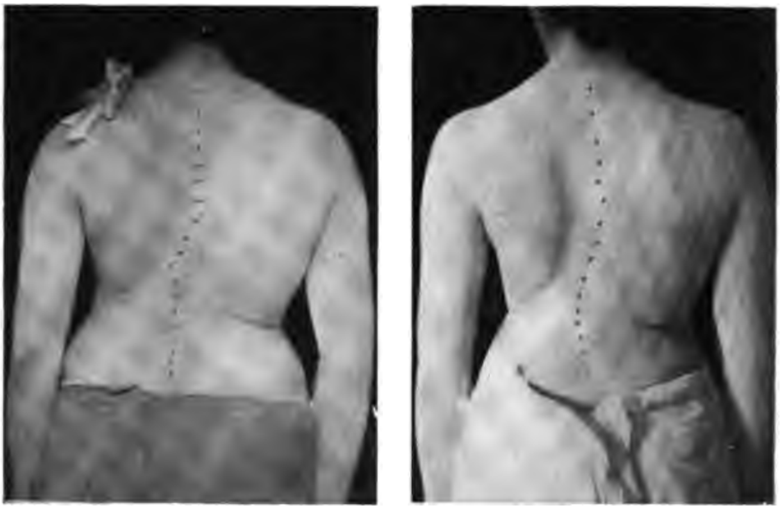

FIG. 5. A girl, age 15 years. This patient refused the forcible correction with jackets, and the photographs show improvement after fifteen months of exercises. Still under treatment.

Taking up a few of the exercises in detail: The first one might be lying face down on the table. The particular child for the movement might have a left low shoulder with the right, a high one, the right upper ribs somewhat prominent from rotation, the right lumbar lateral concavity more marked on the right and the left hip prominent. Consider that these deformities are very mild, so that on assuming the prone position they always disappear with perhaps the exception of the left shoulder, which remains lower than the right.

First must come a voluntary holding of the low (left) shoulder a little higher so that the shoulders will be square across. Next the shoulders are thrown backward until the scapulæ touch behind. This position in itself straightens a mild case. With the muscles held rigid in this position, the upper half of the body (from the pelvis up) is voluntarily lifted upward as high as may be possible while the supervisor firmly holds the pelvis by pressing downward with the hand on the lower sacral region. After reaching the highest point possible, the body is then lowered again while the shoulders are still held rigidly back until the chest is again resting upon the table. Then, and not until then, are the muscles relaxed and the shoulders lowered. This exercise should be a gradual movement, the body not being thrown up with a jerk and allowed to drop again from its own weight, but the whole movement done rhythmically, and with absolute precision.

Another similar exercise is when in the prone position, the arms overhanging the sides of the table at right angles to the body, the arms are first raised as high as possible and then gradually lowered. If done correctly this is a hard exercise and requires constant attention from the supervisor. The child is inclined to raise the arms at an acute angle with the long axis of the body instead of straight out at a right angle. In fact, it is very difficult to do many exercises in succession with the arms thus accurately held. Another point about this exercise is that some children can raise the arms much higher than others. The arms may be elevated until the scapulæ come into actual contact. In doing this, the spine must be kept from bending backward and in some cases the head and chin must be considerably extended, and if it is not done, the spine will bend backward and tend to produce a round-shouldered effect, which is very undesirable and positively harmful if continued.

Another very simple exercise to look at, is when lying upon the back, with the arms by the side, to slowly raise the arms upward until they are perpendicular to the table and then continue the swing until they are flat upon the table behind the head, but it requires practice and a great deal of effort on the part of the supervisor to get a child to do this exercise while the body is held straight as regards its long axis and at the same time to keep the shoulders depressed so that they practically touch the table. This position should be rigidly held while the arms are swung over, and still harder to be held exactly the same while they are swung back again. To thus hold the shoulders and swing the arms seems to be a very difficult thing to do.

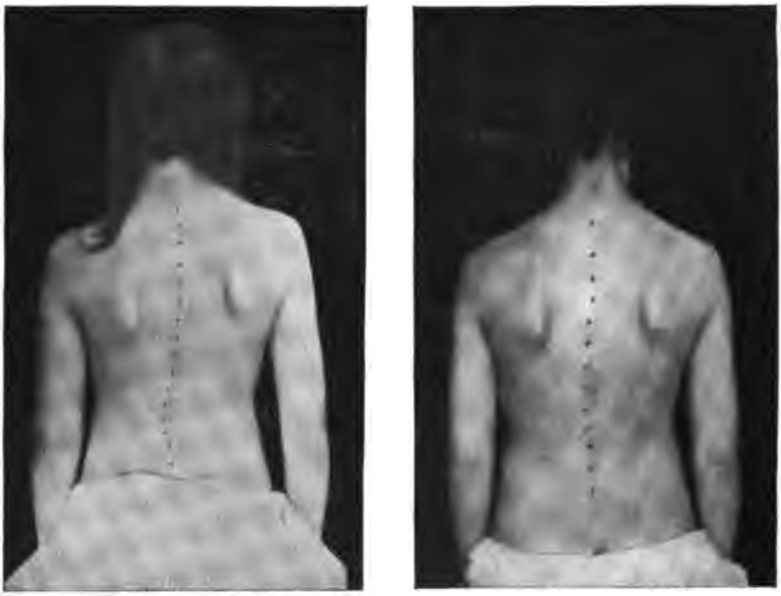

FIG. 6. A girl, age 10 years, shows the improvement of five months of gymnastics.

The exercise before described, of lying face down and raising the arms at a right angle to the body, is continued into another by having the child, with the arms thus elevated, raise the whole body (from the pelvis forward) upward as far as he possibly can and then gradually lower the body to the table again.

Still another is to raise the body as first described and then hold it up there as long as possible, which means until it is seen that the muscles are tiring and that the accuracy of position can no longer be continued, when the body is lowered to the table again. In this particular exercise considerable time is allowed between individual movements so that the muscles will not become tired out.

Another simple movement made difficult, is to lie face down on the table and with hands placed palm down, just about under the shoulders, to then lift the body by pushing upwards until the arms are perfectly straight; this to be done with the shoulders held back until the scapulæ touch behind. Holding the shoulders back is the thing which makes it difficult.

A movement which is always hard to do accurately, is to sit on the end of the table with the feet and legs, from the flexed knee, hanging down and held by a strap in order to get a point of purchase. While in this position, with shoulders thrown back and spine held perfectly rigid and straight, or as straight as is possible, to let the body down backwards until it rests flat on the table, the shoulders and spine to be held perfectly in position while it is being done. Then comes the worst part of it, to slowly raise the body to the sitting position again. It would be easy but for the forcible holding of the shoulders and spine. This movement requires very constant attention and a great deal of coaching.

Another very difficult movement is when lying face down on the table, the hands are placed on the back of the head, then the elbows are elevated to the level of the back of the head and while holding this difficult position the body (from the pelvis forward) is raised upward as far as possible, then lowered again.

All of these exercises must be done rhythmically. The body must not be jerked up, then dropped again. It is not necessary to go through all of the movements in detail, but the standing exercises may be described as a whole by saying that the child must first hold the body and spine and shoulders in a correct position and then *while so held,* certain symmetrical movements executed in a rhythmical manner.

As regards dumb-bells, two or three pounds are the heaviest used and the only mechanical auxiliary now in use is the elastic exerciser attached to the house wall, and the movements are all perfectly symmetrical.

2. MECHANICAL.

The only method in use, except as just described, is that of forcible correction by mechanical means. This is a home-made affair, a gas-pipe frame with semi-circular bands extending over the patient from above. Then by padded disks and plunging rods, pressure may be brought to bear on the various projecting points of ribs, while the body is supported from below by webbing which extends lengthwise of the frame. The pelvis is supported by a rigid cross-bar so that is practically immovable. Pressure is applied in various directions and as much correction made as may be tolerated or as may be deemed advisable.

While the body is thus held, plaster-of-Paris is applied as high as the axillæ and then allowed to set. The child is then changed to the standing position, the shoulders are then included in plaster and while the plaster is soft the shoulders are held by the two operators in an erect or corrected position until the plaster is thoroughly set. Successive jackets applied in this manner correct as much of the deformity as may be possible, when it is omitted and hard gymnastic work begun. A single jacket may go for three months and in the winter, a little longer. Some cases might need only one, others might need them extended through the year; the case reported below was in plaster, with successive jackets, for about fifteen months (see photograph).

As regards the exercises in the cases below reported, they have all attended three times weekly and most of them have done the exercises at home on the other days, but during the past year the home work has been gradually given up because it became apparent that at home they were not done with anything near the precision and accuracy necessary, and in all new cases there is no home work at all. With this omission there is a corresponding improvement in results. With the new cases there is another innovation which is already showing results, i.e., having the children attend every day. This was suggested to me by Dr. Lovett and in the few cases started on these lines, the improvement is very pronounced.

SUMMARY.

The exercises are limited to the symmetrical ones and these must be done with precision and accuracy. It is the elaborating of the fine details of each movement and educating the patient's mind to carry the exercise down to its smallest point and the constant coaching by the supervisor, who must not let a single error go uncorrected, and the frequent attendance (daily if possible) which makes for success in the treatment of lateral curvature of the spine.

Below is submitted some photographs of cases with the results; the results being as you will see some time after beginning treatment, in order to show somewhere near ultimate results.

IV.

PLASTER-OF-PARIS; THE EFFECTS OF VARIOUS SUBSTANCES UPON ITS RATE OF SETTING AND THE SUBSEQUENT STRENGTH AND DURABILITY OF THE CAST.

WALTER G. STERN, CLEVELAND, OHIO.

Plaster-of-Paris is the product of the incineration of a crystalline rock, gypsum ($Ca\ SO_4 + 2H_2O$) at a temperature not exceeding 180° C., at which temperature the gypsum parts with almost all of its water of crystallization and is converted into an amorphous anhydride which possesses the power of recombining with water to form crystals. For use in orthopedic surgery it is quite important that the gypsum from which the plaster is made should be quite pure and hard, should have been finely ground before burning, which process should be carefully carried out because neither underburned nor overburned plaster combines readily with water, and finally reground and carefully sifted. Such plaster, if kept in a dry, clean place, or better in well-sealed containers, should be of a pure white color, of the fineness and consistency of the finest grades of wheat flour and when thoroughly gauged with one-half its volume of water at 72° F. should set in from 6 to 10 minutes.

The chemical composition of strictly pure plaster is $2\ Ca\ SO_4 + H_2O$. It retains approximately 7 percent of the original water of crystallization and is classed as an unstable anhydride. Chemically pure plaster-of-Paris is, however, a commercial impracticability, and still the very best grades of plaster contain only small amounts of impurities. An analysis made by Eckel of two brands of Nova Scotia plaster, the purest in America, which set in 7 minutes with a resulting tensile strength of about 400 lbs. to the square inch, showed:

$Ca\ SO_4$	98.42%	94.87%
$Ca\ CO_2$	1.07	2.64
Silica	.11	2.02
Alumina and other impurities.	.00	.47

This corresponds closely to analyses of the very best grades of French and Italian plaster made by Durand Claye.

Solubility. Gypsum of a specific gravity of 2.3 is soluble in 490 parts of water at 60° F.; the solubility is slowly increased as the temperature rises until at 101° it is soluble in 318 parts of water. The presence of other salts in the water, such as sodium and especially potassium, greatly increases the solubility of calcium sulfate by the formation of double salts. Le Chatelier has discovered in the burned plaster several partial anhydrides of calcium sulfate which are relatively very soluble but unstable and are soon changed into the ordinary insoluble hydrate and then precipitated in the form of interlocking crystals.

Setting. If a solution of gypsum is crystallized by evaporation the crystals which form do not interpenetrate but form a granular mass resembling gypsum; and, unlike set plaster, there is no cohesive power and no strength to the mass. Le Chatelier divides the process of the setting of plaster-of-Paris into

1st.—Hydration of the anhydride and formation of several very soluble partial anhydrides of $Ca\ SO_4$;

2d.—Solution of these soluble anhydrides and their change into the ordinary insoluble hydrated $Ca\ SO_4$, and

3d.—Supersaturation and deposit of interpenetrating, interlocking rhombic crystals of $Ca\ SO_4+2H_2O$. Heat and the salts which have the power of rendering the calcium sulfate more soluble hasten the setting. They also change the form and coherence of the crystals; those resulting from the combination of alum and plaster being in the form of long, fine, light needles and those from the use of potassium sulfate form feathery masses. The time or rate of setting is the time elapsing between the moment the plaster is gauged with water and time when the mass has become hard enough to resist moderate pressure with the fingernail (Sabine). The time of setting varies with the quality of the plaster and the thoroughness with which it has been kept dry. Plaster which has abstracted moisture from the air can only be restored by reheating it to 180° C. just before using. The best qualities of pure plaster set in about 6 or 7 minutes when gauged with one-half their volume of water at ordinary temperature. Experience has proven this to be about the correct time for the best results in the application of plaster casts for orthopedic use. The plaster does not set while still in the water or in the nurse's hands, it allows of sufficient time to carefully apply the bandages before overcorrecting and then does not entail a tedious wait in holding the part in overcorrection before the plaster hardens. Poorer qualities of plaster-of-Paris set in from 17 to 30 minutes; to use these for ordinary orthopedic work they must be "doctored up" by means of the various accelerators which, as will be shown, interfere seriously with the strength of the cast.

Accelerators. Raising the temperature of the gauging water increases the rapidity of the set. Nova Scotia plaster, which will be used as the basis for all experiments (unless otherwise stated) sets in 7½ minutes at 72° F. At 110°, which is as hot as the hand can well bear, it sets in 5¾ minutes.

Common salt (Na Cl) is the most commonly used accelerator and when used in moderate amounts, 2 to 3 percent, decreases the time of setting to below 4 minutes.

Potassium sulfate is the usual accelerator for all brands of quick setting dental plaster and when used in the water to gauge pure plaster shortens the rate of setting enormously. Equal parts of plaster and potassium sulfate when mixed with water harden so quickly that it is impossible to pour the mix out of the dish.

Borax, zinc sulfate, hyposulfate of soda, and potassium alum all hasten setting.

Common (ammonium) alum also hastens setting considerably but the mix foams up and becomes covered with a foamy scum, while the body of the plaster stays full of small bubbles.

"Dental Plaster." The demand on the part of the dental profession for an extremely quick setting plaster for taking impressions has lead to the marketing of many grades and brands of so-called "Dental Plaster;" indeed all the best plasters in America with few exceptions are sold under this trade name. Strictly speaking, dentists require two distinct qualities of plaster-of-Paris, one a very quick setting and brittle impression plaster which should "break with a sharp edge" when pulled off the teeth, and another, a slow setting and extremely strong plaster for models and use in the vulcanizer. The firm of —— Philadelphia, takes cognizance of this fact and sells:

1st.—"A Quick-setting Impression" plaster which sets in 3 minutes and contains upon analysis a considerable amount of potassium sulfate as the accelerator. It is of low strength and durability and not suited for orthopedic use.

2d.—A "Regular" slow setting dental plaster setting in 7 minutes, which is very pure and very strong. Unfortunately most of the plaster obtainable from the dental supply houses under the name of "Dental Plaster" is of the first variety and also quite costly.

Retarders. Sand, hair, fibre, tankage, glue, glycerine, sugar molasses, peas, beans, grain, sawdust, pulp, slag, etc., all have the power of retarding the setting of plaster. Starch, which is used to stiffen crinoline, has no effect upon the rate of setting when used in the proportion as found in the ordinary crinoline-plaster bandage, 1 part starch to 25 parts plaster by weight. To obtain this the meshes of the crinoline should not be finer than 20 to 25 threads to the inch.

Hardening and Waterproofing. The hardening and waterproofing of the finished cast can readily be accomplished by giving it several coats of, or dipping it into a boiling alum solution, followed when dry, by a bath of boiling soap and finally by a coat of melted paraffin which toughens it and allows it to be polished. Models can be made which can be hammered, sawed or turned in a lathe by mixing plaster with 10 percent marshmallow root and dipping into boiling alum when set. Gauging plaster with soluble water glass, as was advocated by Hoffa in a discussion at Atlantic City, will always prove unsuccessful as the plaster hardens instantaneously and becomes coarsely granular but does not really set. Reducing the amount of sodium silicate to the point where the plaster does not become hard and granular, to 12 percent, prolongs the time of setting to 24 minutes. A better way is to coat the cast when finished with a solution of sodium silicate or dipping it into such solutions when possible; this renders the cast extremely hard and waterproof through the formation of a coating of calcium silicate.

Effect of Cement. It has occurred to the writer as it undoubtedly has to others to ascertain the effects of varying amounts of Portland cement upon the setting and hardening of plaster. As seen from Table I, the intimate admixture of from 5 to 20 percent Portland cement does not interfere much with the rate of setting, and repeated trials in cases of club-foot and hip-joint dislocation, where there is a great deal of wear and tear to the casts, have convinced the writer that cement adds materially to the strength and life of a cast and can be used to advantage where durability is desired. The experiments made to ascertain the tensile strength and resistance to abrasion (Tables II and III) confirm this. The only objection which could be raised against the use of Portland cement would be the inability to cut the plaster cement mixture after it has once hardened. This is true only of mixtures containing more than 20 percent cement.

Heat, Expansion and Contraction. All plaster-of-Paris gives off a considerable amount of heat on setting; the quicker the set the less chance there is for the heat to be dissipated and the greater the apparent rise in temperature.

As was well shown by the experiments of Rough, Prothero, Spence, Willson and others, plaster expands upon setting. This expansion amounts to about 1 percent and is always along the lines of least resistance; it reaches its maximum in about 24 hours, after which the plaster contracts slightly while drying out.

Effect of Water. Being almost insoluble, water should have little effect upon a cast once set, but experience demonstrates that water, urine and perspiration soften plaster and make it unfit for further use. Weak acids attack plaster and soften it, hence the use of acetic acid and hydrogen peroxide to assist in the removal of a cast. A freshly broken briquet when soaked in water lost its sharp granular surface and after drying out was found to have lost 10 percent in weight.

Strength and Durability. As far as is known to the writer the necessity for determining tensile strength, compression strength resistance to abrasion, etc., of plaster-of-Paris has never occurred to mechanical engineers and builders, who have, however, made thousands upon thousands of such determinations for cements,

TABLE I. RATES OF SETTING.

Experiment No.	Plaster Used.	Gauged with Solution Containing	Time of Setting in Minutes.	Remarks.
1	Nova Scotia	2 parts Plaster to 1 of Water at 72° F.	7¼ minutes	Used as standard for all comparisons.
2	Italian Alabaster	2 parts Plaster to 1 of Water at 72° F.	8 minutes	
3	—'s Regular Dental Slow Setting	2 parts Plaster to 1 of Water at 72° F.	7 minutes	
4	—'s Quick Setting Impression	2 parts Plaster to 1 of Water at 72° F.	3 minutes	Cost, 6c. per lb.; contains Potassium Sulfate.
5	Nova Scotia	2 parts Plaster to 1 of Water at 110° F.	5¾ minutes	
6	Nova Scotia	10 parts of Boiled Starch	7½ minutes	Proportion of Starch to Plaster—1 to 20.
7	Nova Scotia	Many Gauze Shreds	7⅝ minutes	
8	Nova Scotia	2 percent Salt (Na Cl)	4 minutes	
9	Nova Scotia	3 percent Salt	3¾ minutes	
10	Nova Scotia	4 percent Salt	3 minutes	
11	Nova Scotia	Saturated Salt Solution	20 minutes	
12	Nova Scotia	3 percent Potassium Sulfate	3 minutes	
13	Nova Scotia	4 percent Potassium Sulfate	2 minutes	
14	Nova Scotia	Saturated Potassium Sulfate	Instantaneous	
15	Nova Scotia	3 percent Zinc Sulfate	4 minutes	
16	Nova Scotia	3 percent Common Alum	4½ minutes	Very foamy.
17	Nova Scotia	3 percent Potash Alum	4 minutes	
18	Nova Scotia	3 percent Chrome Alum	19 minutes	
19	Nova Scotia	Lime Water	6 minutes	
20	Nova Scotia	Saturated Sodium Silicate	....	Did not set, became instantly hard and granular, no cohesion between grains. Unfit for cast.
21	Nova Scotia	50 percent Sodium Silicate	....	
22	Nova Scotia	25 percent Sodium Sillcate	....	
23	Nova Scotia	12 percent Sodium Silicate	24 minutes	
24	Potters' Plaster	2 parts Plaster to 1 of Water at 72° F.	15 minutes	An ordinary slow-setting builders' plaster often used in Hospitals.
25	Potters' Plaster	3 percent Salt	6¾ minutes	
26	Potters' Plaster	3 percent Potassium Sulfate	4 minutes	
27	Potters' Plaster	3 percent Common Alum	7 minutes	Foamy mix.
29	Nova Scotia	Mixed with 5 percent. Portland Cement	7 minutes	
30	Nova Scotia	Mixed with 10 percent. Portland Cement	7½ minutes	
31	Nova Scotia	Mixed with 15 percent. Portland Cement	7½ minutes	
32	Nova Scotia	Mixed with 20 percent. Portland Cement	7½ minutes	
33	Nova Scotia	Mixed with 30 percent. Portland Cement	8½ minutes	
34	Spence's Compound	Stirred for 15 minutes	30 minutes	

TABLE II. TENSILE STRENGTH.

Five briquets used for each determination. Briquets kept absolutely dry at a temperature not exceeding 72° F. for 7 days.

Experiment No.	Plaster Used.	Combined With	Time of Setting.	Tensile Strength. Lbs. per square inch.	Remarks.
2	Nova Scotia	Water at 72° F.	7¼ minutes	394 lbs.	Standard for all tests.
1	Italian Alabaster	Water at 72° F.	8 minutes	375 lbs.	
3	—'s Regular Slow-setting Dental	Water at 72° F.	7 minutes	372 lbs.	
35	Nova Scotia	Reinforced with Wire Gauze, 2 layers cut to fit mould	7½ minutes	481 lbs	To imitate Gauze Wire Bandages.
30	Nova Scotia	Portland Cement 10 percent.	7½ minutes	460 lbs.	
32	Nova Scotia	Portland Cement 20 percent.	7½ minutes	452 lbs.	
31	Nova Scotia	Portland Cement 15 percent.	7¼ minutes	450 lbs.	
29	Nova Scotia	Portland Cement 5 percent.	7 minutes	410 lbs.	
6	Nova Scotia	Water containing 10 parts of Boiled Starch	7½ minutes	380 lbs.	
7	Nova Scotia	Crinoline, 6 layers cut to fit mould	7½ minutes	320 lbs.	To imitate ordinary Crinoline Plaster Bandages.
19	Nova Scotia	Lime Water	6 minutes	320 lbs.	
37	Nova Scotia	Briquet soaked in Water for 24 hours after hardening 3 days	....	250 lbs.	
36	Nova Scotia	Reinforced with Basket Wood, 2 layers cut to fit mould	7¼ minutes	213 lbs.	Little or no adhesion of plaster to wood.
5	Nova Scotia	Water at 110° F.	5¾ minutes	211 lbs.	
9	Nova Scotia	3 percent Salt	3¾ minutes	210 lbs.	
39	Nova Scotia	3 percent Hyposulfite of Soda	3¾ minutes	208 lbs.	
4	—'s Quick-setting Impression	....	3 minutes	201 lbs.	In great regard and use by Dentists.
29	Nova Scotia	Gauged with 25 percent- Sodium Silicate and mixed with fresh Plaster and Water	24 minutes	196 lbs.	Lumpy and uneven.
15	Nova Scotia	3 percent Zinc Sulfate	4 minutes	191 lbs.	
12	Nova Scotia	3 percent Potassium Sulfate	3 minutes	180 lbs.	
16	Nova Scotia	3 percent Common Alum	4½ minutes	135 lbs.	Very foamy, briquet light and friable.
24	Potters' Plaster	Water at 72° F.	15 minutes	380 lbs.	
28	Potters' Plaster	3 percent Alum	7 minutes	170 lbs.	
26	Potters' Plaster	4 percent Potassium Sulfate	4 minutes	169 lbs.	Foamy.
41	Lehigh Valley Portland Cement	....	....	772 lbs.	
42	Nova Scotia Plaster	after drying 2 days	....	234 lbs.	
43	Nova Scotia	after drying 14 days	....	408 lbs.	
44	Nova Scotia	after drying 28 days	....	426 lbs.	

TABLE III.

Resistance to Abrasion; Compression Strength per Square Inch.

EXPERIMENT No.	COMPOSITION OF BLOCKS, SIZE 8x3x5: CUBES 2 INCHES EACH WAY.		COMPRESSION STRENGTH. Lbs. per Square Inch.	PERCENT OF LOSS IN WEIGHT IN TUMBLING BARREL.	PERCENT OF LOSS IN WEIGHT AFTER RUBBING ON STONES.
1	Nova Scotia Plaster	Gauged with Water at 72° F.	2332 lbs.	26 percent.	12 percent.
2	Italian Alabaster	Gauged with Water at 72° F.	2159 lbs.	22 percent.	13 percent.
3	—'s Regular Slow Setting	Gauged with Water at 72° F.	2359 lbs.	27 percent.	14 percent.
32	Nova Scotia	Portland Cement 20 percent.	2908 lbs.	18 percent.	10 percent.
30	Nova Scotia	Portland Cement 10 percent.	2599 lbs.	18 percent.	12 percent.
39	Nova Scotia	Portland Cement 5 percent.	2432 lbs.	22 percent.	12 percent.
8	Nova Scotia	3 percent Salt	1109 lbs.	31 percent.	16 percent.
15	Nova Scotia	3 percent Zink Sulfate	1054 lbs.	36 percent.	19 percent.
4	—'s Quick-setting Impression Plaster	....	996 lbs.	41 percent.	19 percent.
12	Nova Scotia	3 percent. Potassium Sulphate	1150 lbs.	46 percent.	21 percent.
16	Nova Scotia	3 percent. Alum—Foamy mix	543 lbs.	54 percent.	25 percent.
19	Nova Scotia	Lime Water	1206 lbs.	....	....

TABLE II. TENSILE STRENGTH.

Five briquets used for each determination. Briquets kept absolutely dry at a temperature not exceeding 72° F. for 7 days.

Experiment No.	Plaster Used.	Combined With	Time of Setting.	Tensile Strength. Lbs. per square inch.	Remarks.
2	Nova Scotia	Water at 72° F.	7¼ minutes	394 lbs.	Standard for all tests.
1	Italian Alabaster	Water at 72° F.	8 minutes	375 lbs.	
3	—'s Regular Slow-setting Dental	Water at 72° F.	7 minutes	372 lbs.	
35	Nova Scotia	Reinforced with Wire Gauze, 2 layers cut to fit mould	7⅛ minutes	481 lbs	To imitate Gauze Wire Bandages.
30	Nova Scotia	Portland Cement 10 percent.	7½ minutes	460 lbs.	
32	Nova Scotia	Portland Cement 20 percent.	7½ minutes	452 lbs.	
31	Nova Scotia	Portland Cement 15 percent.	7¼ minutes	450 lbs.	
29	Nova Scotia	Portland Cement 5 percent.	7 minutes	410 lbs.	
6	Nova Scotia	Water containing 10 parts of Boiled Starch	7⅛ minutes	380 lbs.	
7	Nova Scotia	Crinoline, 6 layers cut to fit mould	7⅛ minutes	320 lbs.	To imitate ordinary Crinoline Plaster Bandages.
19	Nova Scotia	Lime Water	6 minutes	320 lbs.	
37	Nova Scotia	Briquet soaked in Water for 24 hours after hardening 3 days	…………………	250 lbs.	
36	Nova Scotia	Reinforced with Basket Wood, 2 layers cut to fit mould	7¼ minutes	213 lbs.	Little or no adhesion of plaster to wood.
5	Nova Scotia	Water at 110° F.	5¾ minutes	211 lbs.	
9	Nova Scotia	3 percent Salt	3¾ minutes	210 lbs.	
39	Nova Scotia	3 percent Hyposulfite of Soda	3¾ minutes	208 lbs.	
4	—'s Quick-setting Impression	…………………………………………	3 minutes	201 lbs.	In great regard and use by Dentists.
29	Nova Scotia	Gauged with 25 percent Sodium Silicate and mixed with fresh Plaster and Water	24 minutes	196 lbs.	Lumpy and uneven.
15	Nova Scotia	3 percent Zinc Sulfate	4 minutes	191 lbs.	
12	Nova Scotia	3 percent Potassium Sulfate	3 minutes	180 lbs.	
16	Nova Scotia	3 percent Common Alum	4½ minutes	135 lbs.	Very foamy, briquet light and friable.
24	Potters' Plaster	Water at 72° F.	15 minutes	380 lbs.	
28	Potters' Plaster	3 percent Alum	7 minutes	170 lbs.	
26	Potters' Plaster	4 percent Potassium Sulfate	4 minutes	169 lbs.	Foamy.
41	Lehigh Valley Portland Cement	…………………………………………	…………………	772 lbs.	
42	Nova Scotia Plaster	after drying 2 days	…………………	234 lbs.	
43	Nova Scotia	after drying 14 days	…………………	408 lbs.	
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TABLE III.

Resistance to Abrasion; Compression Strength per Square Inch.

Experiment No.	Composition of Blocks, Size 8x3x5: Cubes 2 Inches Each Way.		Compression Strength. Lbs. per Square Inch.	Percent of Loss in Weight in Tumbling Barrel.	Percent of Loss in Weight after Rubbing on Stones.
1	Nova Scotia Plaster	Gauged with Water at 72° F.	2332 lbs.	26 percent.	12 percent.
2	Italian Alabaster	Gauged with Water at 72° F.	2159 lbs.	22 percent.	13 percent.
3	—'s Regular Slow Setting	Gauged with Water at 72° F.	2359 lbs.	27 percent.	14 percent.
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16	Nova Scotia	3 percent. Alum—Foamy mix	543 lbs.	54 percent.	25 percent.
19	Nova Scotia	Lime Water	1206 lbs.	....	....

nor has the dental profession accomplished anything along this line. The mechanical and engineering literature is meager; the few references to be found in dental or medical writings are the many assertions in dental lectures and magazines that "alum and potassium sulfate cause plaster to set soft and to be very inferior in quality" (Prothero); Goldthwaite (Boston M. and S. Journal, 1891, p. 406) says "salt makes plaster brittle;" Martin (Internat. Jour. of Surg., 1895) claims "salt and alum render plaster brittle and makes a poor support," "crinoline sized with starch does not interfere with setting;" Wilson (Phila. Polyclinic, 1893) advises a large handful of salt to the pail of warm water for gauging plaster; Burow (Deut. Zeit. f. Chir., Bd. VI) uses common alum in 1½ percent solution to make plaster set "in the hands;" while Scudder warns against the use of any accelerator saying, "its use is to be deprecated because the plaster has to be applied too quickly for the best results and the brittleness of the plaster is undesirable."

Following the lines laid down by Sabine (Engineer, U. S. A.) in his work on Portland Cement, I have judged the quality of the plaster cast by its cohesive strength as expressed in tensile strength per square inch, which was determined by casting briquets, five for each determination, in standard cement briquet moulds, thoroughly packing same and after hardening and drying for seven days, breaking them in a Fairbank's cement testing machine. The resistance to abrasion was determined in two ways, the first as paving bricks are usually tested, by casting blocks the size of ordinary paving bricks, 8x5x3 in., and after drying and weighing them, placing them in a tumbling barrel with pieces of cast iron and revolving the tumbling barrel rapidly for twelve hours. At the end of this time the blocks were taken out and the loss in weight for each block determined. The second test was to imitate more accurately the actual use of plaster-of-Paris in case of club-foot where the cast often wet is scraped along the floors and sidewalks. Similar bricks were stood on their smaller ends in a wooden frame and after a thorough wetting were dragged along the sidewalks for several hours. They were then dried and the loss in weight determined. The compression strength was arrived at by moulding the plaster into 2-inch cubes and after slowly drying for 7 days crushing the cubes in a Riehle self registering testing machine.

It will be seen from the determinations that pure plaster exhibits about one-half the tensile strength of neat Portland cement. Its strength diminishes enormously upon the addition of any accelerator and as in the use of alum is rendered absolutely unfit for the purposes intended. Small amounts of cement increase the tensile strength and resistance to abrasion. While the use of plaster reinforced by wire gauze has been found empirically to allow the use of lighter casts, the reason for this is to be found in the increased tensile strength of the combination of plaster and wire and consequently the lessened weight of such a cast to give the same strength and durability as a simple one. On the other hand it will be noted that the use of thin strips of basket wood really adds nothing to the strength and resistance of plaster casts.

Conclusion. 1st.—The orthopedic surgeon should select for his use a pure, well made and well kept unadulterated brand of plaster-of-Paris. Such a plaster will set in about 7 minutes, which is fast enough for all ordinary work and yields a cast of the highest strength and durability.

2d.—The use of starch crinoline bandages as the support in the application of the plaster does not interfere materially with either its rate of setting or its tensile strength. The various forms of wire gauze bandages yield a cast of increased tensile strength and therefore a lighter cast.[1]

3d.—Portland cement when used with plaster-of-Paris in amounts varying from 10 to 20 percent yields a cast of superior hardness, strength and durability. It is especially adapted for use about the foot, ankle, and about the thigh in the Lorenz operation.

4th.—Moisture disintegrates, softens and dissolves plaster casts.

5th.—The waterproofing of plaster casts by gauging the plaster bandages in a solution of sodium silicate is impractical. The finished cast should be thoroughly coated with sodium silicate solution after hardening. The hardening of plaster models, shells, corsets, etc., can readily be accomplished by dipping or painting them with a hot alum solution.

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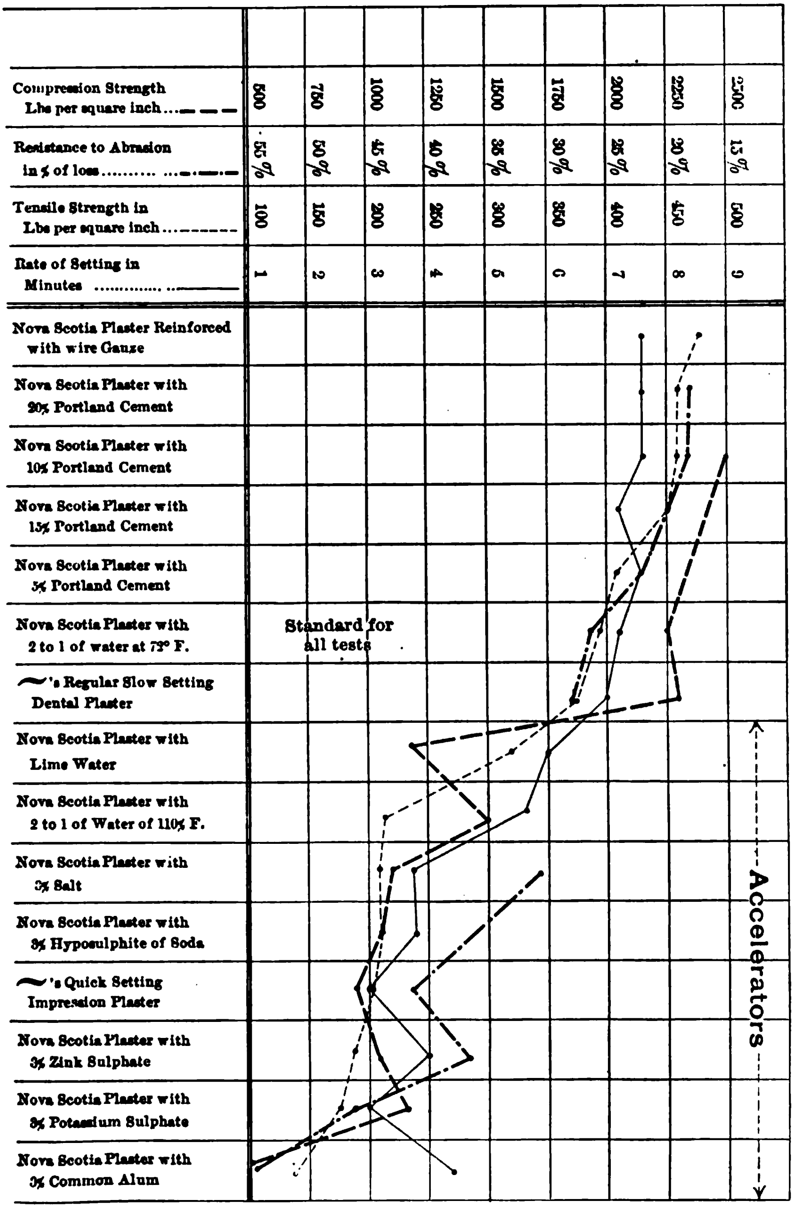
[1] Experience is shown, however, that a wire gauze bandage cannot be used about the foot and ankle on account of the relative inflexibility of the wire gauze.

6th.—The addition or use of any form of accelerator yields a soft and friable set and the cast is of insufficient tensile strength and resistance to abrasion to possess the lasting qualities demanded by the majority of orthopedic procedures. The worst accelerators in this regard are common alum and potassium sulfate. The practice of using poor plaster and then "doctoring it up" with an accelerator to make it harden rapidly should be abandoned.

7th.—The use of "quick setting dental impression" plaster is also to be condemned for the same reasons. They almost invariably contain considerable amounts of potassium sulfate which renders them brittle and friable. The regular slow setting dental plasters obtainable on demand almost everywhere in our country are pure and unadulterated, and when kept in clean, dry containers present the ideal material for orthopedic casts; they can be wound into bandages with starch, crinoline or wire gauze and where especially heavy wear is expected can be advantageously mixed with 10 to 20 percent of Portland cement.

Chart Showing Effect of Accelerators etc.



V.

CONCERNING GENU VALGUM ADOLESCENTIUM.

JAMES T. WATKINS, M. D., SAN FRANCISCO.

During a visit to the Instituto Del Rachitici of Milan some notes, dictated in part by its director, the late Professor Pietro Panzeri, were made by the writer, of an operation for the correction of genu valgum staticum or adolescentium. It consisted in opening, by a forced brisement, the outer part of the lower femoral epiphysis, "epiphyseolysis."

Upon returning to Vienna permission to demonstrate the operation was requested and received.

Experimental operations were first performed upon the cadavers of two boys of suitable ages, to remove from the field of speculation whether or not a true epiphyseal separation would regularly follow a properly executed operation. These experiments were never published.[1] Comparatively recently the opinion has been put forward[2] that in a majority of these cases instead of an epiphyseal separation, an opening of the outer articulation would occur. In dissenting from this opinion these experiments are offered in detail.

At the outset it should be noted that this operation was not recommended for all varieties of genu valgum. Rachitic children of from two to eight years presenting knock-knee were treated for their rachitis and by the application of appropriate apparatus. Operations were discountenanced in these instances.

Older children and adolescents with genu valgum complicated by other deformities, as well as adults, were subjected to osteotomies.

Adolescents up to eighteen years of age, usually persons whose occupation necessitated the long continued maintenance of a standing position, bakers, type-setters, etc., who presented an uncomplicated genu valgum, were treated by epiphyseolysis. In this group of cases the deformity was said to appear late, to be neither preceded nor accompanied by recognizable symptoms of rachitis, and to be confined, as a rule, to the femur in the neighborhood of the knee-joint.

In such an event the most nearly ideal operation would be one which corrected the deformity nearest the joint. A glance at a radiogram of the leg of any growing child will show that an epiphyseal separation must, if feasible, be such an operation. The upper attachment of the joint capsule, be it remembered, reaches as far as the epiphyseal line but not beyond it.

The technic of Panzeri's operation is exceedingly simple. A strong box, twenty centimeters high by as many long and broad, with well rounded edges, is fixed to one end of a table. The top of the box is slightly concave from side to side and slopes perhaps ten degrees towards the end of the table. The patient is placed upon the table and completely anæsthetized. He is then turned on his face with the limb to be operated upon brought uppermost by rotating it strongly outward. The patient is drawn down towards the end of the table, till the leg and knee project beyond the farther edge of the box. An assistant, who stands on a stool, grasps the thigh with both hands, and fixes it on the box by throwing his weight upon it. About one centimeter of the internal condyle of the femur should project beyond the lower edge of the box. A second assistant affords further fixation by holding the knuckles of his fist against the femur just above the patella. The operator stands at the foot of the table behind the patient's leg. The ankle passes under the operator's arm. With both hands he grasps the patient's knee in such a way that he can determine the condition of the external lateral ligaments and of the epiphyseal line; while his fingers inform him of the position of the internal condyle. All is now ready for the brisement forcée. While making slight traction, the operator rapidly sinks his body by bending his knees, and throws his weight on the end of the lever afforded by the patient's leg. In so doing, he is careful to apply the strain in the frontal plane of the patient's leg. His own knees enable him at all times to regulate and control the amount of force used.

A low-pitched sound of long duration, not unlike that produced by tearing a not-too-dry crust of bread, announces the opening of the outer epiphysis. This sound is entirely unlike the sharp report which is heard with a supracondylar osteoclasis. A cupping of the skin similar to that seen at the site of a subcutaneous Achillotomy appears over the epiphyseal separation. The procedure should be carried to overcorrection, however, as the subsequent dressing must maintain the improved position without tension. The complete relaxation produced by a deep narcosis, and the very rapid application of the force in the direction of its frontal plane to the fully extended leg, are necessary to the successful performance of the operation.

It was Prof. Panzeri's experience that these cases, if at once put up in plaster-of-Paris dressings in the corrected position, sometimes developed a peroneus paralysis. Consequently it was his custom to supply them with papier maché splints in the uncorrected position for the first four days, and then to correct the deformity under narcosis, and apply a plaster-of-Paris bandage from the lower ribs to the toes. On the fifteenth day after the operation the plaster was removed below the malleoli and above the inguinal furrows to enable the patient to hobble about. On the fortieth or fiftieth day after the operation, the plaster dressing was completely removed, and after three or four days' treatment of the knee-stiffness by baths and massage, he was discharged cured.

A number of photographs and radiograms of patients taken before and after treatment were seen at the Instituto Rachitici, and several cured patients were examined.

The experimental operations done in Vienna upon cadavers were in no way different from that just described except that in the absence of a specially constructed box an autopsy head-block was used. Post-operative dissections of all four knees were made. The first subject was a well-grown boy of twelve years. In the first knee attacked, a true epiphyseal separation resulted, but the edge of the head-block must have been too sharp, for subsequently a small intra-articular fissure was discovered in the cartilage of the internal condyle.

The other leg of this subject met with an accident. The internal condyle was permitted to slip downward off the head-block. This was observed too late to prevent a fracture just above the condyles, a typical supracondylar osteoclasis.

The operations upon the second cadaver, a boy of fifteen years, were attended with complete success. In each instance, the separation occurred in the epiphyseal line, and was unaccompanied by injury to any other structure.

The dissections of the first, third, and fourth legs, that is, those in which a true epiphyseal separation had occurred, showed that the periosteum had become separated from the bone for a distance of 1 to 2 centimeters above and below the epiphyseal separation. It had remained unbroken, however. In the second the fracture had taken place exactly at the junction of the condyles with the shaft. It was a clear transverse break, except for a tooth-like process half a centimeter long which appeared in the median line of the anterior aspect of the upper fragment. In this case the periosteum was broken on the outer side of the fracture.

In no instance was the epiphysis of tibia or fibula injured.

A few days later, a twelve year old girl was operated upon by the writer at the klinik of Prof. Lorenz. On the right side the usual supracondylar osteoclasis was performed, on the left side, which presented the greater deformity, Panzeri's operation was carried out. On examination and comparison of results a verdict was given for the latter operation. It is still the operation of preference in that klinik and is employed in a rather broader group of cases than that for which it was advocated by Prof. Panzeri.

VI.

INFANTILE PARALYSIS.

The Role of Physician and Specialist in its Treatment.

BY JAMES T. WATKINS, M. D.

Mr President, and Gentlemen:—Three years ago I had the honor of directing the attention of the Medical Society of the State of California to a rational and efficient method of treating by operation the disabilities consequent upon infantile paralysis—called from its originator, the periosteal implantation method of Lange.

After considering the older method of tendon-to-tendon grafting, I said: "It is probable that a very much smaller percentage of good results would be recorded where those cases discarded whose causal lesion was other than that of infantile paralysis; and it would be still further reduced were more time allowed to elapse between the operation and the report of the case. It has been the privilege of the writer to discuss and compare the results of the leading orthopedic specialists in this country and in Europe, and making allowances for individual optimisms, there has seemed to be a fairly universal dissatisfaction with results obtained by the older methods."

By a gratifying coincidence, Dr. Royal Whitman, of New York, one month later, in an address before the American Orthopedic Association, said: "I am inclined to think, therefore, that those who have had considerable experience with the operation, and the opportunity to analyze later the results, will admit that tendon transplantation, in its original form at least, is on the whole, a disappointment."

A year later, Drs. Dane and Townsend, of Boston, presented, before the same association, the results, in tabular form, of an effort to trace and examine 50 consecutive cases of infantile paralysis which had been subjected to operation by different members of the staff of the Boston Children's Hospital. Of these 36 cases had been located. In 7 instances arthrodeses had been performed, with or without tendon graftings, and in 3 instances the astragalus had been removed. The results justified the operations; for a more or less serviceable foot resulted in each instance, whereas the 18 direct tendon-to-tendon grafts that had been performed had resulted in 18 complete failures.

Dr. Whitman considers that the "most frequent cause of failure is the mechanical disadvantage at which the transferred muscle must do its work." While directing attention to this cause, among others, I was constrained by the findings at several secondary operations to assert that the principal cause of failure in tendon-to-tendon grafts, lay in the subsequent stretching of the overburdened tendon of the paralyzed muscle. An opinion which is certainly in keeping with the pathology of the disease.

Both these causes of failure are avoided by employing the method of Lange.*

Indeed a further experience with this periosteal implantation of healthy tendons or of their silk prolongations, has served only to emphasize the excellence of the procedure and to bring us nearer to a precise determination of the principles which should govern its performance.

It is a common experience that, when the corrections of deformities and re-adjustments of muscular power, incident to the orthopedic problem presented by a case of infantile paralysis, have been made, and the limb has been used functionally, muscles that had *apparently* been paralyzed, have been observed to re-acquire tone and function. Since this muscle regeneration is known to occur after operation in cases which presented deformities long, *long* subsequent to the initial attack—that is, in cases which had been neglected or which had had ineffectual treatment—it is pertinent to ask, might not the spread of the paralysis be appreciably limited, and the detail of the final operation simplified, were the latter preceded by an enlightened, thorough, and sufficiently protracted medical treatment?

The detail of such treatment is to be found only in scraps in text-books, despite the fact that it comes properly within the activities of the general practitioner. I shall not apologize therefore for spending five of my fifteen minutes in considering it at length.

It is doubtful whether treatment will check the inflammatory process in the cord. Cupping over the spine has been suggested and would seem a rational procedure. Medication at this stage consists in a brisk purgative, a sedative in the form of the bromide of potash, and full doses of ergot, 10 drops of the fluid extract every four hours for a child of one year.

A month or six weeks later—after the subsidence of the initial invasion—begin with your exercises. Almost no limb is completely paralyzed. Encourage the children to employ whatever strength they have in performing resistance exercises which you or the mother can devise with a cord, a pulley, and a bag of sand.

Be sure that at least twice a day each joint is passively exercised for a number of times, carrying it always to each *limit* of normal motion. If the child is old enough to comprehend you, direct it to move the foot in such a way as will necessitate contraction of the paralyzed muscles, and while it is exerting the appropriate cerebral impulse, yourself carry the member into the desired position to the limit of normal motion. This manœuvre should be repeated many times.

It is of the utmost importance that, both by day and by night, the limb should be maintained, at first in the middle of the arc of its activity, and later in slight overcorrection, the attitude in which the paralyzed muscles are relaxed. Wedging the sole of the shoe, with or without a bar up the side of the leg by day, and at night a simple sheath splint or a so-called night shoe, will usually prove sufficient to prevent contractures. This is absolutely necessary if the inherent contractility of the unopposed muscles, the weight of the limb and especially the weight of the bedclothes is to be successfully counteracted.

Galvanization properly applied and continued for a long time is the next most valuable aid. Since at a very early moment the muscles present the reaction of degeneration—that is, anode closure contraction is equal to or greater than cathode closure contraction—the cathode should be placed on the spine at the level of the lesion and the anode upon the affected muscles. The former should be a large, flat electrode. If the legs are affected, place this electrode over the last dorsal vertebra. If the arms are involved, place it over the cervical spine.

It is important to relax the affected muscles to the utmost by holding the limb in the overcorrected position during the two or three minutes, by the clock, that the anode is being carried back and forth over the affected area. In order to accustom the child to it, begin with only the electrodes, and gradually increase the current a little each day. To be efficient, it is necessary to use comparatively strong currents and the treatment is painful. Therefore it cannot be given over to a parent or nurse. It is the physician's work. Finally a number of make and break interruptions are introduced to cause contractions in the affected muscles. Later when the response to faradism has returned, the galvanic electrodes should be reversed and the galvanic and faradic currents employed upon alternate days.

A vigorous massage should follow your electrical treatment. In my opinion, it is not necessary that one should be an expert masseur for these cases. It has only to be borne in mind that the object of treatment is to help empty the limb of its blood and tissue juices. The arterial system is well able to take care of itself; the massage augments the venous and lymph systems. Therefore the soft parts should be well kneaded and vigorously stroked centripetally till the limb is red and warm. Do this gently at first, and then as the child gets accustomed to it, with increasing force. Teach the mother or attendant to do this massage, for it should be given twice daily.

Frequent baths, at a temperature of 98° F. for 10–15 minutes, followed by rubbing with spirits of camphor or brandy, are said to be of value. And finally, at night, the limb may be wrapped, for an hour, in dry hot cloths, or the hot air oven may be used.

Only two drugs have appeared to be of any value during this stage: Arsenic (arsenious acid in doses of $\frac{1}{40}$ gr.); and strychnia pushed to the limit of tolerance. It is best given with frequent intermissions—say missing every fifth day.

The conservative treatment may then be summarized as follows: Treatment during the acute stage, of doubtful benefit, consists in local counter-irritation, in antipyretic measures and drugs, and in full doses of ergot.

Treatment during subsequent stages, begun one month or six weeks after invasion, consists in exercise—active and passive,

In maintaining affected muscles in a state of relaxation,
In galvanization with reversed electrodes, and, later,
In alternate galvanization and faradization,
In massage twice daily,
In tepid baths and
In dry heat.

Persevered in for a year, this form of treatment, which was that advocated at the Sanitarium of Prof. Hoffa, at Würzburg when I was with him, may be expected to confine the consequences of the disease within the narrowest limits. Whatever paralysis remains however will be permanent. Protraction of conservative treatment will be time lost.

I shall, during my remaining five minutes, discuss the orthopedic problems presented by paralysis of the muscles of the leg; however, the principles which govern their treatment apply equally well elsewhere.

We recognize four essential motions of the foot on the leg—movements necessary to normal progression over uneven surfaces. They are in the order of importance, plantar flexion and dorsal flexion, which take place at the ankle-joint, and supination and pronation, which take place ⅔ in the subastragaloid and ⅓ in the midtarsal. These motions are performed through the agency of 9 long muscles, several of which participate in each motion, and each of which participates in two or more motions. For example, the long extensor of the great toe is also a dorsal flexor and a supinator. While planning an operation not only the major and minor functions of the several muscles must be considered but their anatomical locations and relative strengths as well. It is manifestly impossible to obtain a perfect foot by a re-adjustment of a remnant of the muscular power originally present. Something must remain deficient in the re-adjusted foot; and the deficiency will be proportional to the extent of the paralysis.

After overcorrecting whatever deformity may be present, our aim is to establish these four essential motions—first plantar flexion, then dorsal flexion, and finally the side-to-side motions, so that they can be made independently of one another. To do this we try to replace (*not* graft) the paralyzed muscles by muscles which are anatomically and functionally nearest to them, attaching each muscle or its silk prolongation directly to the periosteum of the foot at the point where it will obtain the best leverage for the performance of its new function. For antagonistic functions, muscles should be employed which have always been capable of contracting independently of one another. Occasionally all the muscles which participate in a certain motion are destroyed, as for instance, in paralysis of the muscles on the anterior aspect of the thigh.

There remain at our disposal only a group of pure antagonists—in this case, the muscles which arise from the ischial tuberosity—with which to replace them.

There can be no question that a transplanted muscle can and will, in response to cerebral impulse, acquire a function antagonistic to its original function, and that the acquired function may in time become automatic; but, unless it was capable of independent action, in the group to which it originally belonged, it will, in its new location, contract only in response to those cerebral impulses which still set up contractions in the muscles of the original group.

Your hamstrings, which have always contracted collectively, will continue to do so, no matter how you may modify their insertions.

Therefore in replacing the lost extensor power by transplanted hamstrings, it behooves us to employ *all* of this group, since to leave one behind would mean only that its pull must be overcome before extension at the knee could be accomplished—a needless dissipation of force.

Further, experience has shown that, except in an unexplained action of the outer half of the tibialis anticus, split-off portions of the leg muscles do not acquire independent functions. Therefore it is incumbent upon us to transplant entire muscles and not parts of them.

Still further, whatever motion obtains at a joint should be under voluntary control. Joint play which cannot be governed is certain to result in the production of a deformity. Where such a loose joint presents, it is best to perform an arthrodesis—to peel off the opposing articular cartilages—and to get an anchylosis of the joint in the most desirable position. The result, as in the 7 cases referred to by Dane, will be a useful foot.

Since, when a deformed foot has been held in overcorrection long enough for the stretched muscles to contract, some of them do sometimes re-acquire their function, it would seem right, as has been pointed out by Hoffa, to hasten their regeneration by shortening their tendons. This procedure has a two-fold advantage. It hastens the regeneration of whatever muscles will regenerate, and removes or diminishes the tension put upon the freshly implanted muscles.

In closing, permit me to use a word of warning. Your patient's parents may have an idea that, on the removal, six weeks after the operation, of the plaster-of-Paris dressings, no further protection wil be needed, it will only remain for him to take up his bed and walk. If so, disabuse their minds of the delusion. Only gradually may a return to the unrestricted use of the foot be permitted; first, in a retentive splint, then in a shoe with either a wedged sole or an insole and uprights. And only little by little—an hour at a time—may he be weaned from them.

The principles of the operative treatment then may be summarized in this way:

1. Overcorrect deformity and maintain the overcorrection for a long time.

2. Replace paralyzed muscles, when possible, by muscles which are functionally and anatomically related to them.

3. For each of the four essential motions supply muscular substance which is capable of independent contraction.

4. Get rid by arthrodesis of whatever joint motion you cannot control.

5. Hasten regeneration or at least restoration of function in overstretched muscles and diminish the tension on the transplanted ones, by shortening the tendons of the former.

6. Protect the limb which has been operated upon, with appropriate apparatus, and only gradually permit its unassisted use.

Much of the excellence of your result will depend upon the thoroughness with which the muscles are trained in the exercise of their new functions. This again is a matter demanding the attention of the mother and of the family physician.

In no branch of medicine may the adage, "make haste slowly," be applied more often than to this grim specialty of orthopedics.

905 Hyde St.

VII.

RESECTION OF THE KNEE WITH THE OBJECT OF OBTAINING A MOVABLE JOINT.

(Preliminary Report.)

GWILYM G. DAVIS, PHILADELPHIA, PA.

In the treatment of ankyloses of various joints operations have frequently been performed with the object of restoring motion in the jaw, shoulder, elbow, wrist, hip and patella.

Operations for loosening an ankylosed patella have been successful but operations on ankylosed knee-joints to restore motion have been avoided.

It has long been known that it is possible to have motion result after a resection.

Sir Wm. Ferguson, in 1856 (Med. Times and Gazette, 1861, p. 601) resected a knee-joint, and five years later the young woman could easily stand on the leg and run up stairs or jump off a chair. Also Thomas Annandale (Brit. Med. Jour., 1877, 478) operated on a child aged 10, removing both surfaces of the tibia and femur and the patella, and while the limb was 1½ in. shorter the child could walk actively on it. He remarks: "The interesting result in this case was quite accidental."

Huguier (Traitement des Ankyloses, 1905, p. 25) says that notwithstanding these exceptional cases we must conclude that at the present time at least one is not justified in attempting to establish the mobility of an ankylosed knee by an orthopedic operation.

The results of resection of the elbow had been so satisfactory to me as regards functional use that for several years I desired to try a similar method on the knee but lacked the necessary courage until the recent work of Dr. Murphy caused me to think an attempt justifiable. Murphy reported in the Journal of the Am. Med. Assoc., Vol. 44, 1905, pp. 1573, 1671, 1749, a series of cases of ankylosed joints on which he had operated, among them there were six of the knee-joint. As far as I can judge they were all cases of fibrous and not bony ankyloses except of the patella in one case. In 4 of the cases after division of the adhesions and capsule lateral flaps of fat and fascia lata and a thin layer of muscle were turned in beneath the patella and between the tibia and femur. In two a transverse incision was used, in one of which the tendo patellæ was divided and resewed, and in the other the

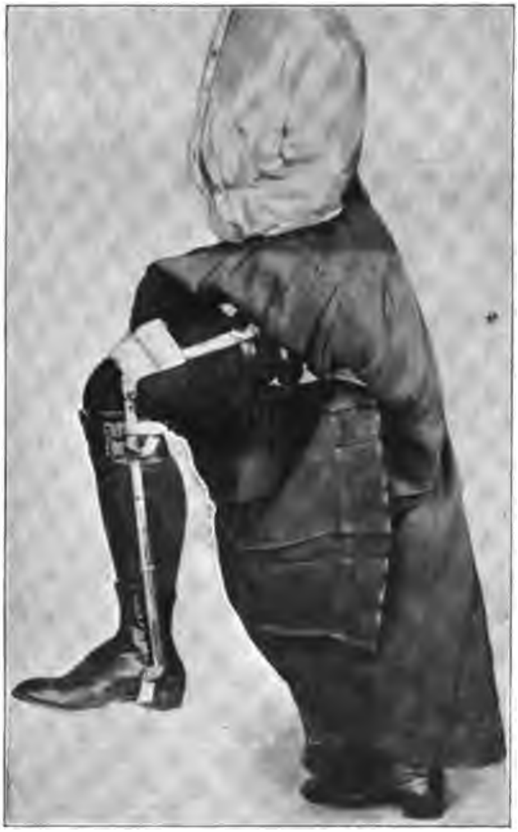


FIG. 1. Voluntary Flexion.

patella sawn across and wired together again and flaps brought from above down.

The results were as follows:

Case 1.—After 5 weeks was having passive motion under anesthesia.

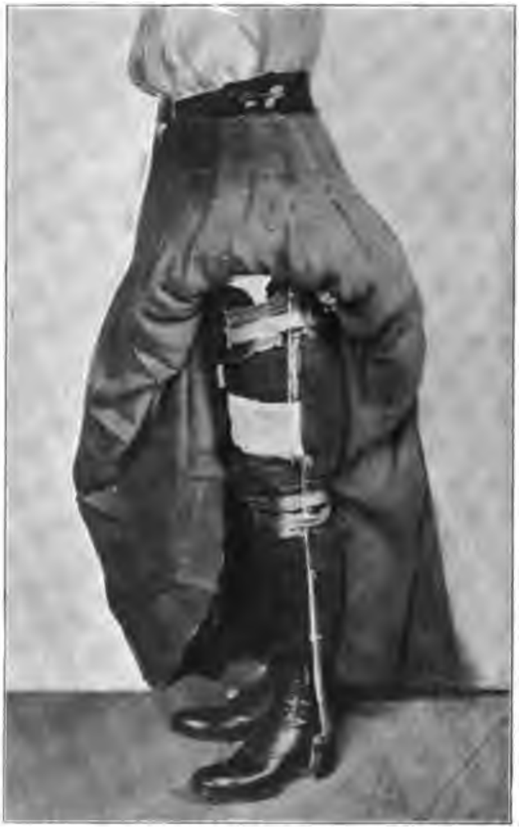


Fig. 2. Voluntary Extension.

Case 2.—After 2 years had 3 or 4 inches of movement in the right knee and about 1 in. in left.

Case 3.—After 3 months had 2° of movement.

Case 4.—After 9 months had 10° to 15° free active and passive motion.

Case 5.—Had a slight degree of movement when operated on and after 2½ months had free movement of 15° which was increasing daily.

CASE 6.—This patient had the patella fixed by long union of the patella but there was 20° of motion between the tibia and femur. After 6 weeks he could extend the limb to within 5° of normal, motion was perfectly free though somewhat limited. Patella free.

In analyzing these cases, Case 6 can be excluded as it was an ankylosis of the patella only. Of the other five the best had 15° of movement which was said to be increasing. From these results it is evident that the question of treatment has not yet been settled. I felt, however, that if 15° of movement had been obtained without removing bone more could be obtained by a bony excision.

A young woman, aged 23, presented herself with a bony ankylosis of the knee at an angle of 130°. It was the result of an attack of general articular rheumatism 3 years previously. She had but slight pain but tired easily in walking and could walk but a short distance and desired something done to straighten the leg and if possible restore movement. The probabilities and possibilities having been frankly explained she decided to be operated on. The operation was performed on Nov. 4, 1905. Two long incisions on the sides of the joint were made and two rectangular flaps about 4 in. long consisting of fat and fascia lata turned down. The patella was sawn loose from the femur horizontally and then a wedge-shaped piece of bone excised 2½ in. (6 cm.) long on its anterior side and 1½ in. (4 cm.) long on its posterior side. The end of the femur was sawn slightly convex and the end of the tibia slightly concave. One flap was turned in under the patella and over the femur and the other drawn transversely over the sawn surface of the tibia and fixed by a few catgut sutures. The limb was put up in an extended position in plaster. Healing by primary union except at drainage-tube opening which remained open perhaps 3 or 4 weeks. When healing was complete an apparatus consisting of two side irons and a screw mechanism to limit the movement of the joint was applied. Movement was so free from the start that the screw was discarded and she was sent home on crutches. It is now 9 months since the operation. The joint can be readily extended straight and flexed at a right angle. The apparatus is essential to give stability to the joint. She can walk ten or eleven blocks (about a mile) using a cane and is still improving. She works in a bank and has resumed her occupation. She is able to carry papers in both hands and walk about the office without any support and can satisfactorily perform her duties, standing about one-third of the time.

While probably too much bone was removed in this case I cannot but regard it on the whole as moderately satisfactory and feel sure it can be made more so. About three weeks ago another case was operated on and less bone removed and the wound is now healed but it is too soon to tell what will be the outcome. Murphy's cases show that if not enough tissue is removed the amount of motion obtained is insignificant; mine shows that if too much is removed a serviceable joint can only be obtained, at least for a time, by the use of an apparatus. Between these two extremes there exists, I believe, a technic which will accomplish the desired end but it is yet to be formulated.

I know of no other case in which a deliberate attempt has been made to obtain a movable joint in complete bony ankylosis of all the bones of the knee.

VIII.

A CASE OF CONGENITAL ANTERIOR DISLOCATION OF THE HIP.

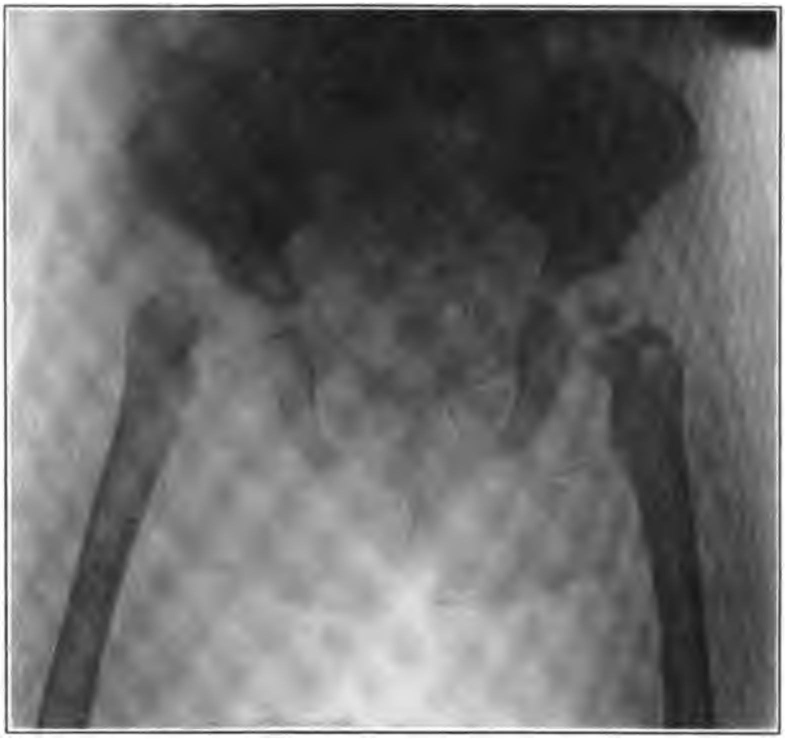
EDWIN W. RYERSON, M.D., CHICAGO, ILL.

Only seven or eight cases of congenital anterior dislocation are reported in the American literature, those of Ridlon, Phelps, Willard and Taylor having appeared in the Transactions of the American Orthopedic Association. The following case is reported merely for record.

Dinah D., two years and seven months old, Russian Jewish parentage, came to the Orthopedic Clinic of the Rush Medical College Dispensary in May, 1906. Normal labor, head presentation, no history of deformity in the family. Brother and sister normal. No sickness except exanthemata. Began to walk at about fourteen months, and an inequality in gait was noticed almost immediately. Never complained of pain or discomfort in hip.

Examination showed a well-developed and nourished child with no signs of rickets. Walked with slight limp of left leg. Three-fourths inch atrophy of thigh, no atrophy of calf. About five-eighths inch shortening. No lordosis. Trochanter about five-eighths inch above Nelaton's line. All motions of joint free except abduction, which is only two-thirds of the normal. Outward rotation is perhaps a little limited. No up and down telescoping. The head of the femur can be plainly felt below the anterior-superior spine of the ilium, and the great trochanter can be felt almost directly behind the head when the foot is pointing straight forward, showing that considerable twisting of neck or shaft has occurred. An X-ray picture shows the head above the acetabulum, and somewhat resembles the picture of the ordinary backward dislocation.

The parents were informed that the joint would undoubtedly be a good and useful one but that, on account of the shortening, it would be wise to attempt a manipulative reduction. They have not, however, returned to the clinic since their first visit.



Congenital Anterior Dislocation.

IX.

REPORT OF CASES OF CONGENITAL DISLOCATION OF THE HIP.

BY GEO. B. PACKARD, M.D.

The question of final results in congenital dislocation of the hip, by manipulative reduction, has been a subject of considerable discussion in the last few years. It is not my intention to give an elaborate paper on the subject, but to report, briefly, my experience in these cases since 1902, with some remarks on the details of management. There are six unilateral dislocations and one double, making in all eight hips that I have operated upon, which will be the subject of this report.

CASE 1.—R. G., a girl of four years of age, came under my observation March, 1903, with congenital, backward dislocation of the left hip. There was one inch shortening. Assisted by Drs. C. A. Powers and Chas. Jaeger, I manipulated the hip for a few minutes, when reduction was easily secured. The usual dressing was applied, which remained on six months. Subsequent dressings were applied at intervals of a few weeks, and the leg gradually brought down to its natural position. Both clinical examination and the X-ray showed an anatomic replacement at different times during the treatment and at the end of three years.

CASE. 2.—G. M., a boy of seven years of age, came under treatment in July, 1903. Shortening one and one-half inches. Dr. Lorenz refused to operate on this case, when he was in Denver, as he considered preliminary extension necessary. After a few weeks' extension by a traction splint, with the assistance of Dr. E. J. A. Rogers, reduction was attempted. A considerable amount of force was used in the manipulations for thirty minutes, when the head was placed in the anterior position, but there was no evidence of reduction. No serious complications followed, but the joint was very sensitive for a long time. The traumatism caused marked stiffness, although the leg was gradually brought down to nearly its normal position. The clinical examination, after two and one-half years, reveals three-fourths of an inch shortening, slight abduction, and the head apparently in the region of the anterior inferior spine. The X-ray showed the neck very short, the head deformed, small and very irregular in shape, and on a line with the acetabulum. The boy walks well, and has a longer, stronger, and more useful leg than before the operation.

CASE 3.—F. F., male, five years of age, posterior dislocation of the left hip. Shortening one inch, operated March 1, 1904. Reduction easily accomplished, stability good. Remained in plaster dressing for fourteen months. X-ray pictures and clinical examination at the time of changing the dressings, and at the end of twenty months showed an anatomic replacement.

CASE 4.—J. C., a girl of three years of age, posterior dislocation of left hip. Seven-eighths of an inch shortening. Operated March, 1904. Well-formed and well-nourished child. Reduction easily accomplished by manipulation, as evidenced by the sound, and the shortening of the ham-string tendons. Stability very poor. The slightest change in the position of the femur, either forward or downward from the right angle, would throw the head out of the acetabulum, and cause relaxation of the ham-string tendons. I did not completely stretch the ham-string tendons—preferring to keep them as a guide, on account of the poor stability. After the plaster dressing was completed, I found the ham-string tendons relaxed. The following day the hip was again reduced, and with great care the dressings were re-applied. The ham-string tendons were found tense, following this dressing, and remained so until they gradually relaxed from walking. In observing the cast on this child for several weeks following the operation, I was impressed by its tightness, and considered, several times, the advisability of changing it, fearing that damage might come from undue pressure, but seeing no ill effects from careful watching, the cast remained on, until the end of six months, and to my surprise the clinical examination and X-ray showed an anatomic replacement. The child was kept in plaster for eighteen months; at the end of twenty-eight months there is evidence of an anatomic replacement, notwithstanding the fact that there was exceedingly poor stability at the time of operation.

CASE 5.—T. R., female, aged two, posterior dislocation left hip, shortening one inch, operated June, 1905, by manipulative reduction. Stability exceedingly good. The plaster dressings were kept on seventeen months, in this case, on account of the age of the child. At the end of eighteen months the clinical examination and the X-ray showed an anatomic replacement.

CASE 6.—R. M., a girl of six years of age, with posterior dislocation of both hips, came under treatment in January, 1905. With the assistance of Dr. E. J. A. Rogers I manipulated the left hip for twenty minutes, and after considerable difficulty reduction was accomplished. On account of the condition of the patient it seemed best to postpone the operation on the right hip. Considerable swelling and ecchymosis followed reduction, which disappeared in a few weeks. In February, one month later, we attempted to reduce the right hip. The reduction was not satisfactory, but the leg was put up in the usual right-angled position. The X-ray showed the head to be in a line above the acetabulum. The cast was changed two months later, and an attempt made to improve the position. After this manipulation the X-ray showed the head to be in a line with the acetabulum. At the end of one year I gradually brought both legs down to normal positions, and found a posterior reluxation of the right hip and the left, a little above the acetabulum, the latter being a good functional result, but not an anatomic replacement; it is one and one-half inches longer than the right, in which a posterior reluxation took place. Another attempt was made in July, 1906, to reduce the right hip, which was preceded by two weeks of extension with an ordinary hip splint, exaggerated traction being made for a few minutes every day, after which the brace was adjusted with extension as strong as could be tolerated, for several hours. After a good deal of difficulty in manipulation, reduction was apparently accomplished, but the stability was exceedingly poor. The dressing was therefore applied with the leg in an exaggerated, right-angled, abduction position.

CASE 7.—J. D., a girl of twenty-eight months, with posterior dislocation, was operated on June 20, 1906, shortening three-fourths of an inch, reduction easily accomplished, stability poor, ham-string tendons not stretched. A few days later, before the child began to walk, the ham-string tendons were found to be relaxed. The dressing was therefore changed, and the leg placed in an exaggerated, right-angled, abduction position. For several weeks following the changed position, the ham-string tendons have remained somewhat contracted, and the X-ray showed the head to be in a line with the acetabulum.

Of course, sufficient time has not elapsed in the last two cases, to form an opinion as to the final results. These eight hips here reported give four anatomic replacements, two anterior transpositions, and two with results uncertain. The results, in eight cases, are not of sufficient importance to base an opinion as to the value of this method of treatment, but they represent the first eight cases operated upon by the writer, and it is natural to suppose that one who has brought to bear his mature experience upon this method, would be still more successful. In the four cases reported as anatomic replacements there is no shortening; the trochanters are in normal position, and the patients walk like normal children. The X-ray pictures also show proper positions. As regards the time for operating by this method, it would seem to the writer that it should be done very soon after the child begins to walk, preferably between the second and third years. The theory that increased age causes greater tone of the soft parts, and consequently, better stability, has not proved correct in the cases cited; the youngest case, two years old, showed better stability of the primary position than any of the others. Naturally the capsule would be more nearly normal at this time, and there would be less likelihood of encountering an hour-glass contraction, accidents, or any unfortunate complications.

Most of the accidents seem to occur from the endeavor to increase the upper age limit—no doubt it can be increased in many cases, depending upon the degree of upward dislocation, and the rigidity of the joints. Failure to make an early diagnosis, or the refusal of unwise parents to have their children treated at the proper age, is not a sufficient reason to discredit this operation, when used in cases where it is indicated. If an attempt is made, later in life, to operate on these children, by this method, at a time when great force is required, and serious complications follow, it is not the fault of the operation, but the lack of judgment in the operator in applying this treatment in improper cases. Because an operation for appendicitis has not been successful in the fourth and fifth day is no reason for condemning it during the first forty-eight hours. The traumatism is so slight at this age it is hardly necessary to consider complications. I have not resorted to overstretching of the capsule, or the muscles; the former would seem to favor forward reluxation, and leaving the ham-string tendons contracted, we have an important, objective sign of reduction. Their sudden relaxation, during the first few days or weeks, would probably mean reluxation, and the cast should be changed, while a gradual relaxation from walking would indicate good position—I think this is particularly advantageous where there is very poor stability. The success in holding the head in position in these cases of poor stability will depend, I believe, upon the accuracy with which the dressings are applied. In Case 4, if I had not re-applied the dressings with the greatest of care as to details, as firmly as possible, without doing harm, I feel sure I would not have obtained an anatomic replacement. If there is any evidence of reluxation from the X-ray or clinical symptoms, the dressings should be immediately changed. If we can keep the head in position for one month we ought to be able to keep it there for one year, and if we can keep it there for one year we ought to be able to keep it there for two years. I can see no reason why splint restraint should not be continued for a long time, if it seems to be indicated. Very little atrophy takes place as long as the leg is functionating, and the adaptive shortening of the pelvi trochanteric muscles from prolonging the right-angled abduction position will have a tendency to prevent reluxation.

Many of the cases of anterior transposition with good function, can surely be called good results, and if these cases are added to those with anatomic replacement, the results are certainly very encouraging. To my mind, this method of treatment offers much more to these afflicted children than the operation by the open method, when we consider that there is some danger of sepsis, ankylosis, or a tendency to flexion and adduction following the latter method.

To one, who, for many years, has felt his utter helplessness when confronted by these cases, the results that can be attained by this method of treatment, applied at the proper age, with practically no danger to the patient, makes us appreciate the great advance that has taken place in the treatment of congenital dislocation of the hip.

X.

REPORT OF A CASE OF CONGENITAL DEFORMITY OF THE WRIST-JOINTS.

FRANK E. PECKHAM, M. D., PROVIDENCE, R. I.

The patient, a girl 14 years of age, came to the hospital August 5, 1904, with both hands deformed as shown in the photograph of the left hand. The photograph was not taken until one side had been operated, as there was no hope entertained of getting much of a result and the present condition was as much of a surprise to me as it was to the girl and that is the reason for reporting it.

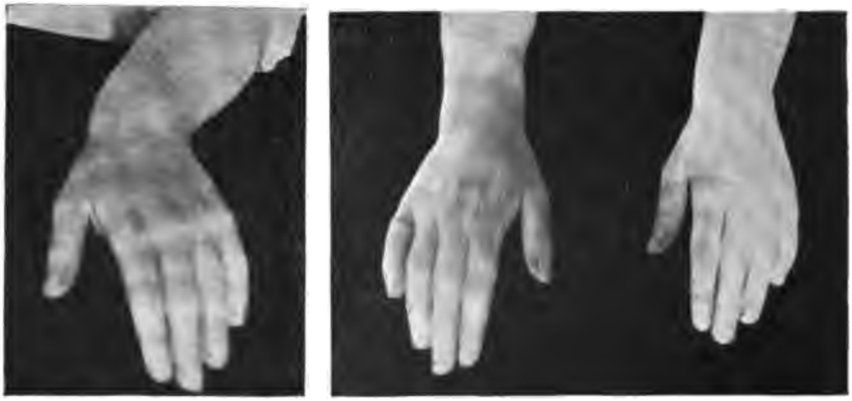
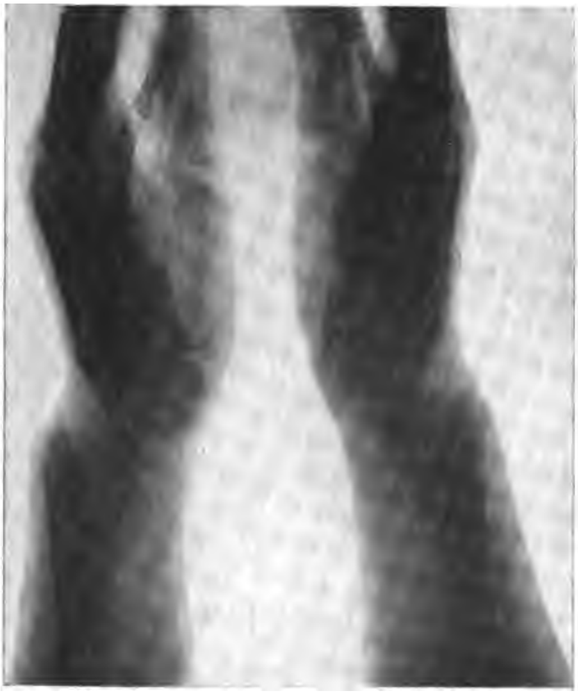


FIG. 1. Before and after operation.

The ulna is seen (in the X-ray photo) extending backward and the space which should have been occupied by the ulna was filled with a thickened fibrous tissue. This was all dissected out, the parts restored to their normal position and firmly held by antro-posterior splints for about six weeks. The resulting stiffness was overcome by hot air baths and massage. At present, the condition of both wrists is as shown in photographs and motion perfect in all directions.

Operation on the right wrist was August 7, 1904, and the other wrist was not done until May 30, 1905.



XI.

A SIMPLE APPARATUS FOR THE APPLICATION OF PLASTER JACKETS IN DORSAL RECUMBENCY.

EDWIN W. RYERSON, M. D., CHICAGO, ILL.

A cheap and simple modification of the Metzger-Goldthwait apparatus has been giving so much satisfaction in the Cook County and Policlinic Hospitals that it seems worth while to describe it.

Two six-inch bars of one-half by one-eighth inch soft iron are bent at the middle to a right angle. These bars are placed back to back, like a capital T, and the stem of this T is slipped into a short piece of half-inch gas-pipe for a support. The lower end of the gas-pipe is screwed into an ordinary plumber's wall-socket or floor-socket, which is a flat casting about three inches in diameter. This gives the T-pipe a firm base to stand on. Another precisely similar T-pipe is made, and the two are placed side by side.

The upper sides of the two T's thus represent the horizontal bars of the Goldthwait apparatus, and press upward against the kyphos on each side of the spinous processes. The T-bars are firmly held in the gas-pipe and furnish a rigid support. A thick piece of felt is laid over the bars, the child's head and buttocks are supported by boxes, and the desired amount of hyperextension is obtained by raising or lowering the boxes. The jacket is then applied with the child in a correct and comfortable position.

In order to allow the T-pipes to come close enough together, it is necessary to saw off one side of each floor-socket with an ordinary hack-saw. A couple of nails or screws through the screw-holes in the sockets will fasten them firmly to the table at the proper distance apart. It is well to file a flat notch in the upper end of the gas-pipes, to keep the bars from slipping sideways. The bars are soft, and can easily be bent to fit any shape of kyphos.

After the jacket has hardened, the child is lifted up, and the jacket, moulded around the pipes, pulls the T-bars out of the pipes. The bars can then be slipped out of the oval aperture caused by the pipes.

Instead of boxes or pillows for supporting the head and buttocks, a pile of boards about twelve by twenty inches will be found very satisfactory, since, by pulling out one or more boards, any desired degree of hyperextension can be obtained without disturbing the patient.

The entire apparatus does not cost more than two dollars.

XII.

EXOSTOSIS IN THE PLANTAR PORTION OF THE OS CALCIS.

E. H. BRADFORD, M. D.

If the os calcis is examined it will be seen that it offers two areas of attachment of important muscles, viz., the tendon Achilles and plantar muscles with, in addition, the plantar fascia. It is well known that under certain conditions, not as yet thoroughly understood, abnormal bone growths are developed at the insertion of important muscles which are subject to strain. It would therefore be expected that in as important a bone as the os calcis, subjected as it is to injuries and strains, there should be found abundant exostoses in these two regions. As the insertion of the tendon Achilles in the upper and posterior portion of the os calcis has already been studied it will not be referred to in this paper. Baer, of Baltimore, has recently published a report of several cases of blennorrhagic exostoses of the anterior and the lower portions of the os calcis. As the subject of foot exostoses is one of interest, it may merit a still further investigation.

Following are the histories of several cases presenting exostoses but where no evidence of so-called rheumatic diathesis existed, and where blennorrhagic conditions were not only absent but had never existed.

Case 1. A young healthy man of 23 years of age, engaged as an operator in the erection of street electric light wires, while at work at the top of a pole fell from the top of the electric light pole, striking with great violence upon his heels, the fall being about 20 or 30 feet. He sustained no fracture but suffered extreme pain. He was able to walk to his residence, being laid off but a short time from activity. Since the accident, however, he has been unable to engage in any active occupation necessitating standing for any length of time. An examination by palpation detected a tenderness on deep pressure on the heel, (i.e., in the anterior part of the pressure surface of the heel). No abnormality in the motion or movement of the feet could be seen. On an X-ray examination a marked projection of bone was found to be present in this region in both feet. As the man's condition was one of practical disability, an operation seemed to be justified. An incision was made along the inner side of the foot close to the sole. The anterior tip of the os calcis was uncovered and the ridge of bone was chiseled off. Convalescence was uneventful and the patient was able at the end of two months to walk with a cane. He was reported to have been able to be at work without difficulty a year after the operation.

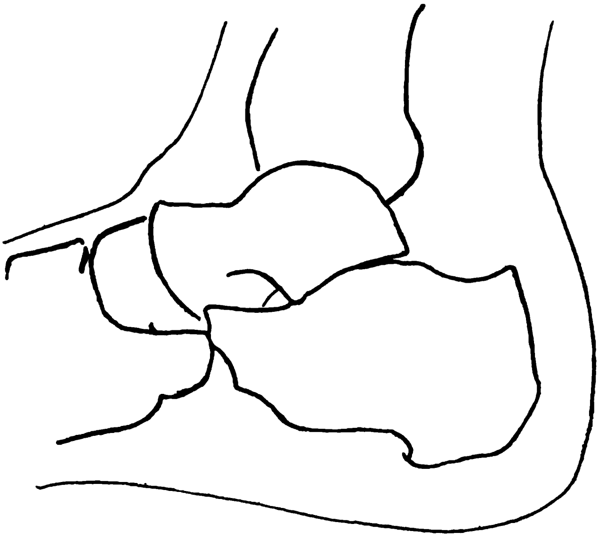


FIG. 1. Tracing of X-ray showing plantar exostosis of os calcis; also projection at upper corners of Os Calcis.

CASE 2. H., a healthy male, 30 years of age, presented himself with a complaint of severe pain on standing, with local tenderness on deep pressure of the heel on one foot, the right foot. X-ray examination demonstrated the presence of a spur of considerable size and an operation was determined upon, which was performed with relief, and from the last record appeared to be permanent.

CASE 3. Woman, age of 30, in apparent health complained of severe pain in the heel on standing, with localized pressure in the anterior portion of the sole of the heel. As for many reasons an operation seemed inadvisable, an arrangement for a cushion heel on the shoe was furnished with apparent relief. This condition has required constant use of the prepared heel.

CASE 4. Woman of 45, of an active nervous temperament, with no evidence of other disease, complained of severe pain in the above mentioned region of the heel, especially in the left foot, although present in both. The condition was relieved by the application of a cushioned heel which was worn constantly for six months, which was afterwards discontinued, but the cushioned heel was subsequently necessary after a period of an unusual use of the feet in standing.

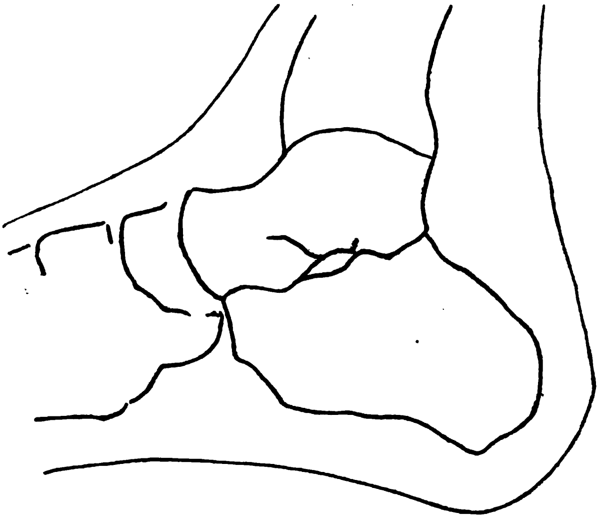


FIG. 2. Tracing of os calcis in same case after operation.

CASE 5. A prominent shoe manufacturer complained of pain in his right heel which interfered with his ability to stand without fatigue. He had endeavored to find relief by all forms of footwear, but without success. On X-ray examination an exostosis was found in the anterior portion of the lower surface of the os calcis and a cushioned heel was furnished which afforded relief.

CASE 6. A physician presented himself suffering with characteristic symptoms of the presence of a spur, which was demonstrated by a skiagram. Relief was given by the use of a cushioned heel which was worn for two months but was discontinued later as the symptoms disappeared. The patient was subjected to an unusual amount of standing.

Other cases might be furnished, but these will suffice to illustrate this condition, which in cases mentioned was found in individuals about 30 years of age, with the exception of the case of traumatic origin presented by the young man of 23. In order to determine how common a condition this exostosis is the writer has been able—through the courtesy of Prof. Dwight of the Harvard Medical School—to examine 90 specimens of healthy normal os calcis. In one of these only was an exostosis present in the region under consideration alone. In a number of other specimens, however, showing evidence of exostosis of the upper portion of the os calcis at the insertion of the tendon Achilles exostoses in the plantar surface were also seen. It would appear, therefore, that the condition is not one of great rarity.

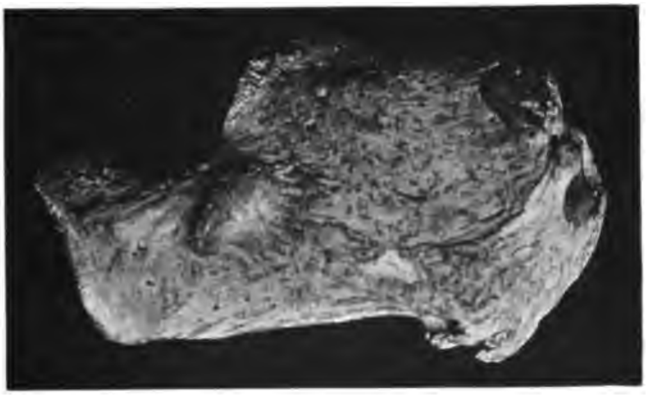


FIG. 3. Os calcis—plantar spurs.

The condition does not present much occasion for alarm beyond a certain amount of fatigue after the patients are obliged to stand continually on their heels; in some cases the disability may be great. It is probable that the effects which have been described by some of the French surgeons, "maladie de sergentes de ville," "sidewalk disease," "maladie de la trottoir" may have been slight forms of this affection.

Where the exostosis becomes unusually large as in the two traumatic cases mentioned, an operation is necessary. From Baer's cases it would appear that in the blennorrhagic condition, the tendency to the bone deposits is increased and these exostoses present. It is also possible that in the common condition known as rheumatoid arthritis, chronic rheumatism, there may be an exaggerated tendency to the development of these spurs.

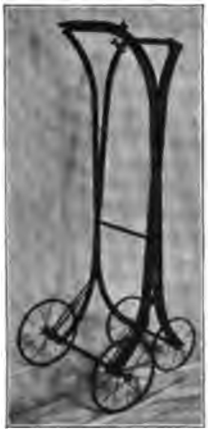
For the relief of this condition the surgeon necessarily considers either operative or nonoperative methods. The operation itself presents little difficulty and no danger. In the two cases in which the writer had the opportunity to perform the operation the cure was apparently permanent; the cases have been seen a year after the operation.

In cases where the operation is not performed, on account of the slight character of the exostosis, relief, as has been mentioned, was furnished by a cushioned heel; a short inner sole of thick leather is fitted to the shoe and to the under surface is attached a pad of sponge rubber sufficient in size to cover the striking area of the heel. This is cut out in such a way as to leave a hole opposite the region where the spur may be supposed to exist. The individual in walking strikes his heel upon the sponge rubber cushion which raises the heel sufficiently to prevent the projecting spur or exostosis from striking upon a hard surface. In certain instances this cushion must necessarily, on account of the size of the spur or bone projection, be of considerable thickness, thereby causing a certain amount of annoyance to the wearer of the shoe. Where this is the case a cushioned heel can be made by removing the ordinary leather heel from the shoe and substituting in its place a pad of sponge rubber, which can be excavated to the extent of one-half inch, or at the point where the projecting spur impinges; this pad of rubber can be covered by sole leather as is done in the application of a cork sole. It will be found in many instances that the relief furnished by the constant wearing of the cushioned heel for several months will not only be temporary but the bruised tissues, from the protection furnished, will recover a sufficient amount of resistance to make the constant use of a rubber cushion unnecessary after several months of treatment, unless an unusual amount of standing is demanded.

XIII.

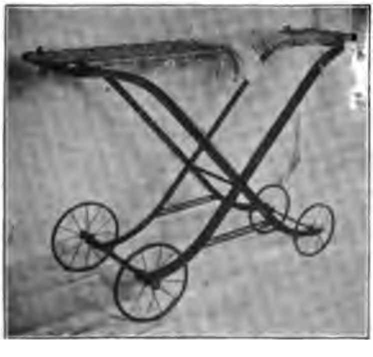
A CARRIAGE FOR STRETCHER FRAME.

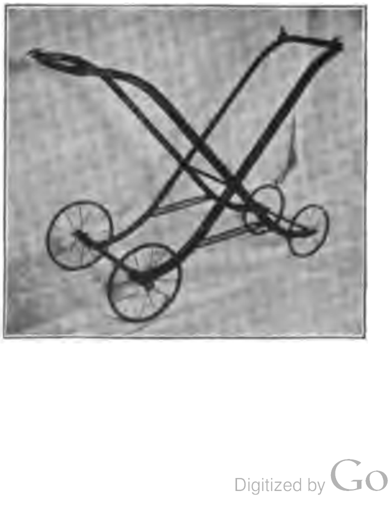
BY JOHN C. SCHAPPS, M. D., BUTTE, MONT.



It is constructed of one inch angle iron with go-cart wheels and axles. The stretcher is clamped to the carriage by short pieces of iron, one inch by one-eighth, curved to fit over the pipe, and secured by thumb screws. The same carriage will serve for several stretchers.

It was devised by Messrs. William L. Miller and William Stussy, of Butte, Montana.





XIV.

TUBERCULOSIS OF THE SKELETON.

A Study of the Location of Tuberculous Foci in Relation to Posture.

ROBERT J. TERRY AND NATHANIEL ALLISON, ST. LOUIS.

A number of observations in the fields of anatomy, pathology and animal experimentation, point to the origin of certain cases of tuberculous arthritis in man, at spots adjacent to the epiphyseal joint, and indicate that such foci follow injuries which are prone to occur in certain joints on account of their special adaptation to the erect posture. Bradford and Lovett, **90**, have made reference to a correlation between the upright posture and the frequency of tubercular disease in the vertebral column and joints of the lower limb, and Lannelongue, **86**, has thought that the great physiological strain to which these parts are subjected has its influence in determining the location of the foci. Lannelongue and Aschard, **99**, have made some experiments to study the relation of injury to the origin of joint disease, and it seems to us that in their manipulations of epiphyses in young animals, these investigators were testing in some instances the effect of physiological strain.

A study of the literature leads us to believe that one kind of injury which operates as a cause in the locating of bone tuberculosis has been overlooked. We think the evidence from pathology and animal experiments indicates that an injury is done in or near to the epiphyseal joint through strain on the epiphysis and that the injury is more frequent at the hip and knee because the epiphyses are exposed to extraordinary strains in the functioning of these joints in the erect posture. In the case of the spine the origin of the disease at the epiphyseal lines of the body appears to be less frequent than its inception beneath the anterior longitudinal ligament. The same agency, strain upon particular centra, we believe to be the principal one in determining the prevalence of the disease in the dorso-lumbar region. We are basing a series of experiments on this hypothesis, the proposed work being really an extension of the experimental field entered upon by F. Krause, **91**.

A review of statistical studies and hospital reports will show the relative frequency of localization in the various parts of the skeleton. From Alfer, **91**, the Boston Children's Hospital, **95**, Cheyne, **95**, the Hospital for the Ruptured and Crippled, New York, **84**, Jaffe, **83**, James, **93**, Judson, **90**, Lannelongue, **86**, and Menzel and Billroth, **80**, we have compiled a record of 22,233 cases of tuberculous bone and joint disease, which is a sufficient number to base conclusions upon. We find that in 39.1 percent the localization is in the spine; in 31.4 percent in the hip; and the remaining 29.5 percent divided among other articular regions, the relative frequency in a series of 12,745 cases being:

Knee,	1887
Ankle,	919
Elbow,	348
Wrist,	135
Shoulder,	123

In Alfer's table of 1752 cases, we find that the spine was diseased in 239 instances, the bones and joints of the lower limb in 880, the bones and joints of the upper limb in 387, the thorax and skull in 155, and several bones and joints together in 91 cases.

Regarding the localization of the infection in the vertebral column, the Whitman, **01**, and Dollinger, **96**, compilations, comprising 1893 cases, show that the thoracic vertebræ are most commonly the seat of disease, and that the lower bones of the thoracic region are most often affected. The same tables show that the upper lumbar vertebræ are almost as frequently attacked as the adjacent thoracic vertebræ.

A comparison of the hip and shoulder-joint, based on Alfer's statistics of 1752 cases, shows the occurrence of 241 affections of the former joint against 28 of the latter. The knee and elbow-joints were diseased 281 times and 114 times, respectively; the ankle and wrist-joints 43 and 20 times.

It is evident, therefore, that tuberculosis, striking thus the vertebral column and the lower limb, attacks most frequently parts of the skeleton which are specially adapted to the functions of support and locomotion in a body that stands erect.

Tuberculosis of the bones and joints occurs at all ages but it is commonest in childhood and youth. Rövsing has seen, in a period of three years, tuberculosis of the skeleton in seven children under the age of fourteen months. It is interesting to find that the shoulder, sterno-clavicular joint, hip, foot and knee, were attacked in these infants (quoted from Krause). According to Billroth, about one-third of all cases occur during the first ten years, a sixth in the second decade, therefore, one-half between one and twenty years. The frequency diminishes as age advances. Billroth reckoned a certain number in later life as due to the reawakening of the foci established in youth. Bruns, **94**, has found that hip-joint disease is practically limited to the first two decades, the period of growth for the upper end of the femur. The association of the disease in its early stages with the epiphyseal region has long been recognized and the results of a number of investigations have indicated that the vascular system of the part is in one way or another the cause of the frequent localization there of the pathological process.

It is also well known that tuberculosis of the skeleton is commoner among males than females. It is probable, too, that the right and left sides are unequally attacked. Mundan, **96**, has found that the right wrist is more often the seat of the disease than the left. These facts support the view that injury has a causal relation to the onset of bone and joint tuberculosis.

While Krause's experiments on animals, to be referred to later, showed the prevalence of primary infection of the synovial membrane, such an origin in man is uncommon, a belief supported by the recent observations of Nichols, **98**. A tuberculous focus is situated most often in the vascular, spongy bone of an epiphysis, or of a short bone; rarely in the shaft of a long bone (Krause, page 19; Nichols; Lovett; Whitman). The invasion of the shaft, sometimes found in children, occurs near one of the epiphyses. Spina ventosa is an exception to this rule. Nichols, **98**, has described the appearance of the primary tubercle in bone marrow, of the formation of secondary tubercles, their caseation, and the coalescence of several in the production of an irregular caseous mass. When the extremity of a long bone is affected, the tuberculous center is commonly found situated deep in the bone, away from the articular cartilage, but near the epiphyseal cartilage (Krause, page 20). This center may be in the epiphysis itself, or in the spongy bone of the extremity of the shaft, next the epiphyseal cartilage. In Nichols' experience, the disease in the femur "frequently begins in the epiphyseal line between the head and neck." His Figure 3, page 365, shows a primary tubercular focus in the epiphyseal line of the tibial head of a child five years old.

Wedge-shaped foci occur in the epiphyses of long bones, also in the vertebral bodies, in the astragalus and calcaneus. Müller, **86**, has asserted that about one-fifth of the two hundred cases of hip, knee and elbow tuberculosis examined by him, showed foci more or less wedge shaped. The base of the wedge is commonly toward the articular cartilage, but sometimes toward the epiphyseal cartilage.

The invasion of a bone may be in connection with the periosteum, as is often the case in spinal caries (Krause, page 19), where the first morbid changes are seen on the surface of the vertebral body, beneath the anterior longitudinal ligament (Krause, page 42). Nichols, however, found the disease to begin in the marrow in the anterior portion of body. The anterior part of the body is certainly the region in which the pathological process commonly begins, and not the middle of the centrum, as is sometimes claimed. Just as in the case of a long bone, the disease of the spine may begin in the epiphyses. Krause, page 42, says that tuberculous foci are prone to develop at those places in the vertebral column where the most active growth of the bone is going on, namely, at the transition from bone to periosteum and to the intervertebral fibrocartilage.

Many experiments have been carried on to determine the relation of trauma to bone and joint tuberculosis. It has been shown that in animals which have been inoculated with tuberculous matter, foci develop in joints which have been wrenched or strained (Hüter, **72**; Schüller, **80**; Krause, **91**). Krause infected forty-four guinea-pigs, strained certain of their joints, and found that the disease attacked these joints in fifteen cases. Like experiments on twenty-eight rabbits resulted in fourteen cases of articular tuberculosis. The inoculation was intravenous in the case of the rabbits and intraabdominal for the guinea-pigs. With one exception, the disease attacked only the joints which had been strained. No explanation is offered why all the joints which were injured did not develop the disease. The form of the disease was primary, synovial tuberculosis, identical with that in man. In two of the rabbits, and in one guinea-pig, foci in the bones were present, but independent of the infected joints. In one of the rabbits and the guinea-pig the epiphysis infected was ununited as shown in Figures 54, 55 and 56. As will appear later, it is of importance to know if all the animals were young or adults or of different ages. Similar experiments, made by Lannelongue and Aschard, **99**, to determine the relation of wounds to the local disease resulted negatively.

Articular tuberculosis can arise in young animals that have been infected with weak cultures, although the joints have apparently not been injured. Courmont and Dor, **90**, infected five young rabbits by intravenous injection of weak cultures of tubercle bacilli. Not until the sixth month did there appear typical white swelling in several joints, in all the rabbits, though no injury had been inflicted by the experimenters. The knee, ankle, elbow and shoulder-joints were especially affected. The synovial membrane and the ends of the bones were diseased, and the bacilli were present.

Müller's, **86**, experiments of injecting tuberculous pus into the nutrient artery of the tibia in kids and Cheyne's injections of pure cultures of the tubercle bacillus into the nutrient arteries of goats resulted in local tuberculosis of the bones.

Experimentally articular disease arises in infected animals after straining a joint; through general infection of young animals, when no injury was inflicted; by injections into the nutrient arteries of tuberculous material in young and adult animals.

Bone tuberculosis has, therefore, been observed to have its origin under differing conditions.

The fact that localization of foci can be determined by injury is known, therefore, by the direct evidence afforded by experiment, and it is supported by the prevalence of the disease in childhood when falls, sprains and other injuries are most frequent; by its commoner occurrence in the male; by the observation of Mundan, referred to above, and by the evidence of clinical records. While little value can be allowed for the statements made by patients in respect to injuries, there can be no doubt, that as Nichols says, "Injuries of moderate severity favor the production of the disease." The observation of a relation between sprained ankle and tuberculosis of the foot, recorded by the French War Ministry, quoted by Krause, and the careful statistical study of Wiener, 97, cannot be disregarded. It is commonly stated that the wound is usually slight (Krause, page 160; Lannelongue, page 56; Whitman, page 195; Young, page 61); sprain is often found to have preceded the onset, dislocation and fracture rarely.

To summarize the observations on injury in relation to the onset of tuberculosis in bones and joints, we can say that straining or wrenching a joint in infected animals is frequently followed by primary disease of the joint and sometimes of a neighboring epiphysis independently of the joint infected. The bone infection has been found to be present in young animals, and the focus near the epiphyseal line.

The location of the focus near the epiphyseal joint suggests the probability of an injury at or near the epiphyseal line, the result of a disturbance of the epiphysis at the time the joint was strained. The probability of the occurrence of such an injury is supported by the evidence already adduced, namely, the prevalence of the disease during the period of active growth of the bones when the epiphyses are ununited, which is also the period of greatest activity of the individual.

We wish now to point out some anatomical conditions which also favor the view that the injury which gives occasion for the development of a tuberculous focus is done in the growing regions of the bones in man.

The erect posture necessitates many changes in respect to the weight-bearing functions of the limbs and the vertebral column over the conditions present in quadrupeds. The weight borne by the vertebral column in man is relatively much greater than in lower mammals, since besides the viscera there are added the head, thoracic skeleton and upper limbs. An enormous weight in consequence is put upon the lower limbs, which are straightened in two stiff columns of support.

While invertebrate animals possess many pairs of limbs, repeating the functions of support and locomotion, higher animals, with the body strengthened by a vertebral column, have but two pairs. Reduction in the number of limbs cannot go further without lessening the stability of the body and the quadruped appears to be the animal best organized for standing and running. Among animals in which the thoracic limb is adapted to flight or prehension, and in consequence the pelvic limb is called upon to sustain the weight of the whole body, the standing position lacks stability. In man the center of gravity is placed high and the base of support is limited to the small area included by the soles of the feet.

Standing depends upon the stiffness of the limbs, a condition attained in most mammals, where the segments of the limbs meet at angles, by the contraction of the extensor muscles. In a few rare instances the joints are adapted to aid the muscles, or even to relieve them entirely. This is the case in man where the erect posture is maintained by the rigidity of certain joints, through the agency of powerful ligaments. The strain put upon these check-ligaments is not only great but protracted. Meyer, **67**, has estimated the strain upon the ilio-femoral bands, in checking the sinking of the pelvis in standing, at five times the weight of the trunk. This band is bent over the front of the head of the femur, in stretching between its places of attachment. The small surface at the level of the epiphyseal line of the femoral head, upon which the articular cartilage extends, and against which the ilio-femoral band presses, is regarded by Turner and his pupils as an adaptation to the pressure of this band. In the extended position of the leg, as in standing, the lateral and popliteal ligaments and the anterior crucial ligament at the knee are put upon the stretch. Stability at the ankle is obtained by muscular action and by the obliquity of the axis of the joint. Through the latter condition great strain is put upon the malleoli when the body tends to sway forward or backward.

The movements of the vertebræ are limited by ligaments and in certain regions by articular processes and ribs. The dense fibro-cartilaginous disc and the longitudinal ligaments limit flexion, extension and rotation in regions where bony processes do not afford the means. The last named movement is generally regarded as absent or very slight in the lumbar region, where the relations of the articular processes check any tendency to twist about a vertical axis passing through the middle of the body of the vertebra. Rotation in the thoracic region is permitted above the tenth bone. Thus twisting of the upper part of the trunk, which may be a very powerful action, is brought to an end, so far as movement between the vertebræ is concerned, at the tenth thoracic vertebra. The strain on the succeeding fixed bones must be very great, and is met by the ligaments principally, for the articular processes (except the lower pair of the twelfth vertebra) are not adapted to limit rotation. The dorso-lumbar region is subjected to great strain in the rotary movements of the upper part of the trunk, and the strain is borne largely by ligaments.

We would now recall the places of attachment of the ligaments connecting long bones and the bodies of the vertebræ. They are *always in part or wholly connected with the epiphyses.* We cite the intervertebral discs and the anterior longitudinal ligament of the spine; the lateral, popliteal, and crucial ligaments of the knee; the lateral ligaments of the ankle. The ilio-femoral ligament is fixed to the epiphysis of the iliac spine above; it is bent over and exerts a great pressure, increased by extension, on the front of the epiphysis of the head of the femur.

The contrast in structure of the pectoral and pelvic limbs in adaptation to their special functions is so familiar as to need no review. The function of the pectoral limb in man is prehension. During a brief period only while the infant is creeping does the arm take part in locomotion and support. In accordance with its special function a great variety and range of movements are present. In only a single large joint is movement restricted to one kind, namely, in the elbow. Check-ligaments, which play so important a part in the mechanism of the lower limb, are rare in the arm, the joints of which are not subjected to severe and protracted strain.

The experiments of Hutchinson, **93**, show that the separation of an epiphysis of a long bone is not a difficult matter. He cites a large number of cases in his practice. Even a slight disturbance of an epiphysis could hardly occur without injury to the growing region.

The great strain on the ligaments of the spine and lower limb can be and often is much increased by slight changes of equilibrium, slight over-extension of the hip or knee, or a little turn of the ankle. From the great leverage in all of these joints, it needs but slight change from the normal position of the parts to increase enormously the strain on the check-ligaments, and, therefore, upon the epiphyses. We see under these conditions how a slight accident can strain or wrench a joint, an injury which pathologists have found to be sufficient for the initiation of a tuberculous focus in an infected animal. It seems to us that *the structure and mechanism of the joints of the lower limb and spine in adaptation to the erect posture, the relative instability of the body in this position, and the disposition of the weight to be carried, all combine to render the growing regions of the bones in question specially liable to injury.*

Observations on the early stages of bone tuberculosis are as yet insufficient to prove what conditions ensue when a joint is wrenched. In the experiments now under way we are subjecting certain joints and the vertebral column to strain of a definite kind and degree in both young and old animals with proper controls in every case. It is our intention to study the results at different times subsequent to the date of the operation.

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